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FORESTRY EDUCATION IN INDIA

SARDAR PATEL'S thought-provoking address at the Convocation of the Indian Forest College, Dehra Dun, early this month, deserves to be assimilated by a much wider public than the handful of young aspiring foresters to whom it was primarily addressed. In his characteristic and forthright manner, Sardar Patel deplored the "cruel exploitation of this vital national wealth (forests) and criminal waste of capital placed in our hands by a bountiful nature". But, he asked, "How few have the attitude of reverence and consideration for the trees and plants that sacrifice themselves in the service of mankind?" And this, in spite of the fact that "forests satisfy our basic needs with a universality which might well be the envy of those who believe in bringing wealth within the reach of all." After a graceful tribute to the work of Dehra Dun, the Deputy Prime Minister had some kindly words of encouragement and advice to the new graduates in the "career" which he exhorted them to regard as "a field of duty".

This address has served a public purpose in focussing attention on the importance of forestry education as an integral part of a sound forest policy. It will be remembered that the Far Eastern Forestry Conference which met in Mysore a year ago, emphasised the point in a resolution. Again, the Third World Forestry Congress meeting in Helsinki last July gave its considered opinion that "Forestry legislation, research, education of forest owners and workers, and training of a sufficient number of professional foresters and technicians—all in conformity with the constitution and structure of each country—constitute essential elements of such a policy." And Forestry Education is rightly considered to be the keystone of such a policy. It is therefore worth while examining the existing set-up and future possibilities for education in forestry in our country.

The pattern of forest educational policy in India has in the main followed—there are critics who aver that it has been even subordinated—the requirements of Governmental forest services. In general, the top-men were imported and the less attractive posts were open to local talent. It was almost an article of faith that the superior posts needed training abroad. It is worth while recalling that even

under the Montford Reforms, "Forests" were a "Reserved" subject and it was "transferred" to the Ministerial part of Dyarchy as a consequence of the Muddiman Committee Report. The controlling posts of the Forestry Services were almost the exclusive prerogative of the ruling race; these recruits were trained, for the most part, at Cooper's Hill, Bangor, Nancy or Oxford. And, the admission of any Indian into this charmed circle savoured of a favour. These Indian recruits had also perforce to be trained abroad, as there were no institutions in India for training "Officers". The Forestry Colleges at Dehra Dun and Coimbatore trained Indians for either provincial services or as rangers.

It was just about 25 years ago that the Government of India decided upon the inauguration of the I.F.S. course at Dehra Dun—an innovation which was considered almost revolutionary at that time. The experiment was, however, shortlived because on account of the virtual cessation of recruitment to the services during the great depression of the 1930's, the course was abandoned. And, it was not again till 1938, during Sir Jagadish Prasad's tenure as Member in charge, the course was revived at Dehra Dun and styled the "Superior Forest Course". Immediately after, the second World War intervened and again upset the apple cart. Many a plan of development had necessarily to be put in cold storage till happier times. We are all familiar with the turbulent events that followed, culminating in the achievement of the country's independence. And, the institution of a parallel course at Coimbatore in 1948 is to be suspended this year, mainly, it is announced, on account of a substantial fall in the recruitment for the Forestry Services. The ranger's course at Dehra Dun is fortunate in having enjoyed more continuity. Also, the Dehra Dun Ranger's College has been supplemented by a number of Provincial Forestry Schools designed to provide rangers for the provincial cadres. No Indian University offers forestry courses leading either to a Diploma or a Degree.

A feature of the training at Dehra Dun, specially of the "Superior" course, is its expensiveness. The cost to the student of this two-year "superior" course is of the order of Rs. 12,000. This is very high, compared either to the costs of training in many other countries in the world (where standards of living are much higher than in India) or *vis-a-vis* the general level of income and cost of living here. In fact, it is doubtful if the technical training for any other profession in India costs more than forestry training. The facts that forestry training is intensely practical and that it involves extensive touring all over the country no doubt do contribute to the cost but do not account fully for the high bill. Whatever the reasons be, the expense has in effect shut out a great many otherwise promising students from Dehra Dun unless they happen to be Government or state scholars. This has tended to give Dehra Dun a flavour of exclusiveness which is not met with in many other leading European Forest educational institutions.

This, in brief, is the present position. And now that the country is free to set its own house in order to conform to its needs, its convenience and ideals, we are of opinion that the time is opportune to re-examine the whole question of forestry education in the country. Are the existing facilities sufficient—in quality and quantity? What are the advantages in having several levels of training—"superior", provincial and the like? Who should prescribe and ensure standards of training—Central Government, State Governments, Universities or *ad hoc* bodies? Is it necessary or even desirable that Forestry education should serve exclusively or primarily the needs of service recruitment? What role can the Universities play in Forest education and research? How best can Forest education help in fostering Forestry as a *profession*—the maintenance of its integrity, development and the promotion of an *espirit-de-corps* amongst its practitioners? Why cannot we develop the Indian centres with our resources in men and material and fine traditions of forestry into international centres for education in tropical forestry? Forest education and technique could well form important export items of the country. They may not earn much in foreign exchange but they can and will earn international good-will and rank high in prestige value.

This bald statement (by no means comprehensive) of the more important issues involved indicates the complexity and manysidedness of the problem. They do not admit of categorical answers without much more detailed and

expert examination; nor could the answers be implemented without co-operative endeavour salted with high national purpose.

These decisions and their translation to action necessarily take time. Certain mental re-adjustments can well precede them. The Forestry Service in the country is no longer an exotic transplanted from outside the native soil and conditioned to suit the convenience of an alien people. And while we should thankfully remember the work of the foreign pioneers, there is no point in enshrining and perpetuating the elements of superiority and aloofness which were noticeable features of the earlier tradition. Artificial distinctions based on mere prerogative and privilege have to make room for natural leadership born of aptitude, knowledge and experience. And Forest education should recognise these needs and be designed to cater to them.

This does not imply any admission that Forestry education should forever be the handmaiden of service needs. On the contrary, there is a good case for introducing elementary forestry as one of the optional subjects in the science degree courses of our universities. Such an arrangement would benefit the student should he take up forestry or agriculture as a career; even otherwise, it would benefit him as a citizen by its intrinsic worth of scientific discipline and cultural value. (All those who study zoology in the university do not necessarily become entomologists nor does everyone who studies music sing on the stage.) It would widen the field of selection of the future professional forester and research worker. It would enable the universities to build up vigorous schools of forestry research. More than all, an intelligent appreciation of the role of forestry in the national economy would be widely disseminated in the fabric of the community. This is a very great gain. For, the formation of informed, responsive public opinion is essential, especially in a democratic set-up, for the practice of scientific forestry which often prescribes and insists on the subordination of temporary, sectional and immediate gains to the ultimate and permanent good of the community as a whole. It is not without significance that in some of the Scandinavian countries—amongst the most advanced in the world in forestry and with democratic forms of government—quite a number of students study forestry not to make a living or profession of it but just for its cultural and prestige value—as, for example, a law degree is taken in England.

The question of training Indian foresters outside India is a cognate problem. While there can be no doubt of the advantages of carefully selected Indian students receiving post-graduate training in specialised courses outside the country, the sending of a raw recruit for a first degree in a foreign country is waste of money and can become less than useless. As already mentioned earlier, the British recruits to the Indian Forest Service were trained, for the most part, in British institutions where the teachers were mostly retired members of the Indian Forest Service itself. Whatever its other merits, the system did not tend to promote a catholicity of outlook. This has since changed and a welcome feature of Indian Forestry in recent times is the increasing number of men who go out to study at reputed centres outside Britain.

We must repeat and emphasise however, that the centre of education for Indian Forestry must be India itself. Forests cannot be exported and Indian forests can best and only be studied in India. We are only too aware that many a post-war development scheme in the country is stymied by almost insuperable practical difficulties whose impact is cooling down the first flush of enthusiasm and sobering the high expectations. At such a time, it is comforting to know that the development of forests and forestry education present a field wherein *all the basic requirements are to be found within the country itself.* There are no difficulties connected with heavy investment; import of equipment; purchase of patent rights; exchange quotas; procurement of trained personnel and the technical "know-how"; and the many other hurdles of most other development schemes wherein almost the only role India is called upon to play is to pay humbly and hopefully.

For Forestry Education, on the other hand, all that is required is a clear enunciation of the objectives to be aimed at, preparation of careful plans to achieve these, and their implementation according to a time-table which takes account of our resources in men and material. We commend that this be done soon—the sooner the better for our forests and for the country.

QUANTITATIVE RELATION BETWEEN YARN STRENGTH AND FIBRE PROPERTIES

K. R. SEN, D.Sc.

THE writer in 1938 gave[1] an equation for calculating the yarn strength from fibre properties as under:

$$S_L = A \frac{l\,p}{f.c}(1 - E) \qquad (I)$$

Here, S_L represents the single thread strength of a cotton yarn of count, c, obtained by using a test length, L. l denotes the mean fibre length, p, the mean fibre strength and f, the mean fibre mass per unit length. The quantity A is a numerical constant which depends on the definition of the count with respect to the units of measurement considered. E in this equation embodies the various effects brought into being by the conditions of the yarn structure. Experience shows that the resultant of these effects, which E expresses, whenever significant, is detrimental to the realisation of the full strength of the fibre aggregate in the yarn. The effect of the test length on the yarn strength is also covered mostly by the *omnibus*-term, E.

The Spencer-Smith equation for flax derived from statistical considerations, in 1947, takes the form—

$$Q_L = Q_0\left[1 - \frac{\omega_n \cdot F(n) \cdot V_0}{100}\right] \qquad (II)$$

Here, Q_L is the average quality number of a long specimen of yarn of length, L, Q_0 is the mean quality number of the "fracture zone" or the length within which the actual fracture is confined (Turner[5]). ω_n denotes the mean difference between the average and the minimum value of n terms selected at random from the appropriate normalised frequency distribution (Tippett[6]), $F(n)$ is a function depending upon the serial correlogram of the strength of the fracture zone; and V_0 is the percentage of variation of the strengths of the fracture zones.

The form of the Spencer-Smith equation being similar to the author's, it was considered worth while to publish the method by which the equation (I) was derived and also to scrutinise and compare the two equations.

(A) *Derivation of Equation* (I)

Equation (1) is built up from the following considerations:—

(i) *The strength of all fibres within the smallest specified or standard test length.* This standard length for cotton is considered to be the same as the average fibre length. We may represent the strength of the yarn of a length equal to the average fibre length by S_l.

(ii) *The increase in strength caused by* (a) *the binding effect of twist on fibres constituting the yarn; and* (b) *the frictional resistance offered by the mutual surfaces of contract opposing any slippage under tension.*

These positive effects of strength are physically known facts and may be together denoted by T.

(iii) *The decrease in strength, due to* (a) *possible non-clamping of some fibre-ends in the main region of fracture,* a fact which is likely to permit easy displacement of such fibres under the applied tension; (b) *the pre-existing tensile strain in some of the component fibres,* the magnitude of which varies according to their distribution between the surface and the core of the yarn (these differences in magnitude occur as a result of the differences in the twist angle); as well as (c) *the statistical effect of the longer actual test-length due to the presence of the thick and the thin places in the yarn.* These irregularities of yarn-structure are caused by the unequal relative displacement of the fibres along the length of the yarn during drafting, and constitute the most important source of reduction in yarn strength. The resultant negative effect on the strength of the yarn may be denoted by—F.

In addition to these principal factors there may yet be others which are either positive or negative in their effect on the yarn strength. Such minor factors are often local, arising out of the machine conditions and/or some peculiarities in the structure of the yarn or the constituent fibres. These are yet undefined, and their total effect, as far as experience goes, may be neglected for all practical purposes.

Now, to derive equation (I) in the simplest manner, let G represent the *maximum*† strength of the yarn from fibre fracture only, when a test length equal to the average fibre length is used. It is common experience, and also a matter which can be theoretically understood, that the fracture of the fibres, which occurs, is *not confined to one particular cross-section,* but is distributed over various cross-sections within a length $\geq l$ or just $< l$. It cannot be

† It is the total aggregate strength such as would obtain on the breaking load of all the fibres concerned being realised.

greater than l*. The harder the twist, the smaller is this length. It happens thus. A fibre must break at the weakest point; this point may, however, be situated anywhere within its length. So, the points of break of the fibres, broken by the application of the tensile stress, will be situated within a zone $\geq l$ at different distances *from any particular cross-section*, for the individual fibres concerned. Thus the breakage of the yarn will spread over a region of its length, instead of being confined to a point. But the spread of this region of break along the length of the yarn, will, of course, naturally depend on the frictional and other effects brought into play by the degree of applied twist. We can not, therefore, expect to arrive at the true aggregate strength of the fibres in a test length equal to the average fibre length by confining ourselves to a particular cross-section only, to the exclusion of all others involved in a yarn break. We must take into consideration for practical reasons, all the fibres, whole or part, such as lie within the length, l.

Now, from previous considerations, $S_l = G + T - F$; also F is very much bigger than T; and $G > (F - T)$. This latter inequality is clearly proved by the fact that the resultant strength observed for a yarn is real and positive. Thus we may write,

$$S_l = G - (F - T).$$

If then we express $(F - T)$ in terms of G such that $F - T = e.G$, where e is a proper fraction depending on the structural characters of the yarn, we ultimately get,

$$S_l = G(1 - e). \qquad \text{(III)}$$

In order to evaluate G, we must find a way to estimate the number of fibres which, on an average, lie within the length l of the yarn. To do this let L represent the actual test-length of the yarn in a yarn-break test. L is many times larger than l. Representing the total number of fibres which lie within the length, L, by N_L, the average number per unit length, may be taken as N_L/L. Let this quantity be represented by N. In a test length equal to the average fibre length, l, the number of fibres, on an average, will then be practically equal to Nl. (As L is kept constant for all yarns, $N \propto N_L$.) On these considerations we may put,

$$G = Nlp$$

The mean value of N can, however, be obtained in this manner. The average mass per unit length of the yarn $= A \div c$, A and c being as defined earlier. The mean fibre mass per unit length being f (see *ante*), the average number of fibres per unit length of the yarn, or N $(= N_L/L)$, should be given by $A \div cf$, Therefore, $Nl = Al/cf$. So,

$$G = Nlp = A\frac{lp}{fc}. \qquad \text{(IV)}$$

Thus we get the value of G in terms of the properties of the yarn and the component fibres. So, from equations (III) and (IV), we have for the yarn, having a test length equal to the average fibre length,

$$S_l = A\frac{lp}{f.c}(1 - e).$$

Now, calling $c.S_l$ as Q_l or the "quality number" of the yarn, when the test length $= l$ we may write,

$$Q_l = A\frac{lp}{f}(1 - e)$$

There is one point which requires to be considered here. For such a small test length as the average fibre length of cotton, the effect of the strength gradient should be extremely small for statistical reasons. It is in fact found to be practically insignificant.[9] Also, as most of the fibres are likely to be clamped (*cf.* Sen & Nodder[7]) at both ends at this test length, the possibility of slip under tension significantly affecting the yarn strength is negligible. Further, the diameter of the normally twisted cotton yarn being small, and the number of twists per unit length fairly large, any difference in twist on fibres in the yarn must be small. The negative effect being thus greatly reduced, since however the effect of T must be practically unaffected, the value of $F - T$ must be regarded as negligible compared with G. In other words, $e = 0$. On these considerations,

$$Q_l = A\frac{lp}{f}.$$

However, for an actual test length, L, which is many times longer than the average fibre length, the specific conditions reducing 'e' to zero, do not exist. It is in fact found from experience that with the usual test length, L, the loss of strength due to the effect of yarn structure,

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* As soon as one or more fibres at any point in the test length has broken, the remaining fibres about the point gets the share of the load which, therefore, increases rapidly per fibre as fibres break, precluding yarn-break anywhere outside the zone (*cf.* Turner). Use of the average fibre length, l, as the minimum test length for calculation of yarn strength therefore corresponds to the *limiting* "fracture zone". A significantly shorter length than l cannot also fulfil this condition.

which brings down the value of G, is considerable. So, for a test length = L, we may represent¶ F — T by E.G and get—

$$S_L = A \frac{lp}{fc}(1 - E),$$

which is the same as the equation (I). Representing $S_L \cdot c$ by the corresponding "quality number", Q_L, we may write—

$$Q_L = Q_l (1 - E). \qquad (V)$$

This reduces equation (I) to a form identical with that given by Spencer-Smith.

Value of E

There is a great deal of difficulty in evaluating E physically in terms of the fibre properties. It is so because of the general structural uncertainties involved in even such a yarn as may be regarded as the nearest approach to the ideal from practical considerations. This led the writer to fall back upon the then existing results of measurement of the properties of the fibre and the yarn and, with their help, to develop an arbitrary scheme, of E with reference to the gradations of count of yarn and the intrinsic strength of the fibre. The intrinsic strength, p/f, termed by some as the fibre-breaking length and by others as tenacity, was shown by Balls[3] to be a most important character governing spinning quality. It was found (Sen[8]) that the agreement between the observed yarn strength of cotton and the yarn strength calculated from equation (I) using the given arbitrary scale of E was reasonably close.

From a large number of data[8] it was concluded that generally the observed and the calculated values based on the arbitrary scale of E differed by less than 5% of the former. A few cases with larger difference (~10%) were also noticed. The largest differences (~20%) were however found in the case of the binary mixtures of different cottons and may have been caused by lack of perfect homogeneity of the mixed product affecting the observed yarn strength.

¶ It is to be noted that while the symbol, c, has been used for use in case of a test length, l, equal to the average fibre length, for *any actual* test length, L, the symbol used is E. The length gradient of strength, for instance, is an important contributor to E, but has rather an insignificant effect on c. Considering the dimensions of the quantities which take part in equation (I), it appears that the factor E has the inverse dimension of length.

(B) Comparison of Equations for Flax and Cotton

Equation V derived above and Spencer-Smith's equation for flax (equation II) seem to possess the following common features—

(i) Both the equations represent the relation between the count-strength product (quality number) of a yarn at a long test length and that of the same yarn at the shortest standard or assessable test length.

(ii) Both the equations contain a reduction term for strength at the shortest standard test length. This expresses itself in the equation as deviation from unity, of the ratio :

$$\frac{\text{Count-strength product at the observed test length}}{\text{Count-strength product at the specified shortest test length}}$$

Thus in both cases, the count-strength product obtained at the shortest specified test length requires to be multiplied by a suitable proper fraction to obtain the count-strength product at a desired test length.

The principal point of difference between the two equations is that the basic test length is the average fibre length in the case of cotton, and the length of the fracture zone in the case of flax. This point may be discussed further.

The mean length of cotton fibre which can be easily spun varies from 0·5 inch to slightly over 2 inches. The maximum in the case of the Indian cottons, however, hardly exceeds a little over an inch. On the other hand, the mean filament length of flax is several times longer than the maximum length of cotton. Unlike therefore the case of cotton which possesses very short filaments, there is distinct possibility of occurrence of significant effect of a fibre strength gradient in the case of the long filaments of flax. This possibility precludes the use of the average length of flax as the shortest standard or assessable length. The same reasoning also applies to any other long textile fibre such as wool, jute, nettle, ramie, etc. Now, Spencer-Smith (*loc. cit.*) has pointed out that the mean length of the fracture zone of normally twisted flax yarn is about 0·5 inch. With this length used as the test length of flax yarn, the effect of the strength gradient of the yarn is undoubtedly obviated, the clamping of the fibres at both ends may also be assumed generally, and no complication due to the strength gradient of the fibre may be expected. Thus the principal,

advantages of using the average fibre length of cotton as the shortest standard test length, are obtained in the case of flax if the length of the fracture zone is adopted.

There is another point calling for attention, viz., the "difference" term which is E in equation (V), and

$$\left[\frac{\omega_n \cdot F(n) \cdot V_0}{100}\right]$$

in equation (II). In using the length of the fracture zone as the shortest test length, Spencer-Smith has pointed out that the relationship between the adjacent fracture zones arises from the fact that one flax fibre may spread over several fracture zones (apart from the question of any random variation imposed by the machinery). But when we use the average fibre length as in the case of cotton, i.e., when short fibre materials are under consideration, the effect of this factor should be insignificant. It is therefore regarded that F(n) which is based on the above consideration in the case of flax (as well as of other long fibres) *cannot persist as an important factor in the evaluation of the difference term for cotton and similar other short fibres.* In other words, the strength-reducing quantity E for cotton should not be significantly influenced by the correlation of the adjacent small lengths as indicated by Spencer-Smith to be the case with flax.

It may be worth-while to explore both the physical and the statistical possibilities which govern the values of the slippage factor E.

(C) The Applicability of Equation (I) to Jute

With respect to equation (V), it may be pointed out that the author[10] observed in the case of jute yarns a *linear* trend between the adopted measures corresponding to Q_L and Q_I respectively. This indicates that for jute which is a long fibre, the effect of the "slippage factor", E, is not very important.

However, the possibility of wide variations in the measurements, particularly of p, in the case of jute filaments, and the fact that "fibre-length" of jute is, so to say, created by the processes involved in spinning, make the applicability of the equation to this fibre only of academic interest.

1. Sen, K. R., *Science and Culture*, 1938, **4**, 5. 2. Balls, W. L., "*Studies of Quality in Cotton*," London, 1928. 3. —, *ibid.*, p. 252. 4. Spencer-Smith, J. L., *J. Text Inst.*, 1947, **38**. 5. Turner, A. J., *ibid.*, 1928, **19**. 6. Tippett, L. H. C., *Biometrica*, 1925, **17**. 7. Sen, K. R., and Nodler, C. R., *Tech. Res. Mem., I. C. J. C.*, No. 9. 8. Sen, K. R., *ibid.* 9. Balls, W. L., *ibid.*, 206. 10. Sen, K. R., and Nodler, C. R., *Tech. Res. Mem., I. C. J. C.*, No. 7.

FUEL RESEARCH INSTITUTE

THIRD in India's chain of eleven National Laboratories, the Fuel Research Institute at Digwadih (Dhanbad) in Bihar is due to be opened on April 22, 1950, by the President, Dr. Rajendra Prasad.

The Institute will conduct research on major problems concerning fuel — solid, liquid and gaseous—and will operate a physical and chemical survey of Indian coals, to provide a reliable assessment of the quality and quantity of the various coal resources of the country.

In addition to problems of fundamental and applied research, sampling and analysis of coal will be undertaken and pilot-plants are to be developed for various processes.

The Institution's work will be distributed among the following main divisions: Coal Survey and General Analysis; Carbonisation and by-products; Liquid fuel (including hydrogenation, synthetic fuels, petroleum and substitutes); Physics (including X-ray and Spectroscopy); Gaseous Fuels (including gasification); Engineering (including preparation of coal for the market, coal-washing, boiler plant and combustion engineering).

The Director of the Institute is Dr. J. W. Whittaker, who will be working in consultation with Dr. S. S. Bhatnagar.

There will be six Regional Coal Survey Stations working under the Institute for the physical and chemical survey of coals and will be located at: the Raniganj coalfield, with a laboratory near Disherghar; the Jharia field with its laboratory at the Central Institute at Digwadih, the Bokaro-Ramgarh-Karanpura fields with a laboratory at Ranchi, the Eastern States coalfields (Vindhya Pradesh) with a laboratory at Umaria, Sagra Estate; the Madhya Pradesh (C.P.) coalfields, with a proposed laboratory at Kamptee near Nagpur, and the Assam coalfield with a proposed laboratory at Dibrugarh.

PILLOW STRUCTURES IN THE LAVAS OF DHARWAR AGE IN THE CHITALDRUG DISTRICT, MYSORE STATE

C. S. PICHAMUTHU
Director, Mysore Geological Department, Bangalore

THE author's attention was drawn recently by Raghunatha Rao* to a few outcrops in the Schist Belt of Chitaldrug District which, according to him, exhibited very well the orbicular structure.

The occurrence of these structures had been noticed earlier by Jayaram[1] who considered them to be a "curious spheroidal breccia". In his opinion, the dark hornblendic rock has been intruded by the grey trap and the resultant hybrid rock presents these structures in which the rounded and angular hard fragments of grey traps are separated by thin flow bands of dark hornblende schist.

The following are some of the localities where these structures are clearly seen: —

(1) △ 2326 near Maradihalli, about 1½ miles due east of the 114th milestone on the Bangalore Chitaldrug road; (2) the northern flanks of △ 2521, about 1 mile east of the 116th milestone on the Bangalore-Chitaldrug road; (3) △ 2141 near Kallenhalli, just south of the 7th milestone on the Chitaldrug-Challakere road; (4) △ 2234 south of the 9th mile on the Chitaldrug-Challakere road and about a mile WNW of Balenhalli and (5) the rise south of △ 2389, and north-west of the 9th milestone on the Chitaldrug-Challakere road.

Of the above localities, these structures are best seen on △ 2326, west of the village of Maradihalli. The photographs illustrating the present note are from this hillock.

In the author's opinion, these are undoubted pillow structures which have been preserved in fairly good condition, despite the age of these lavas.

The distance between the first and the last spot mentioned above is over eleven miles, and so this phenomenon is not of very local occurrence. The genetic relationship of pillow lavas to the physical conditions under which the rocks consolidated has rendered these structures of great importance in working out the structure and stratigraphy of lava flows. Detailed geological mapping in this region would undoubtedly throw further light on whether these different outcrops belong to a single flow or to different flows; in either case, this discovery should afford some assistance in working out the stratigraphical succession in this part of the Chitaldrug Schist Belt.

* Geologist, Mysore Geological Department.

The pillows are usually ellipsoidal or irregular, and rarely spherical in shape. They vary in size from about eight inches to two feet (*vide* Fig. 1). Many of the pillows are flattened or indented by contact with neighbouring ellipsoids. The pillows are sometimes connected with one another, and in rare cases appear to have formed as a bud from a larger mass.

FIG. 1. From hillock west of Maradihalli. The well-defined "skin" and radiating joints of the pillows are clearly seen. The pillow below the handle of the hammer has pushed itself between two other pillows suggesting its plastic nature when formed.

FIG. 2. From hillock west of Maradihalli. Weathered block of pillow lava. Note the fissile skin, the circular and elongated vesicles, radial jointing, and the indentation caused by neighbouring pillows.

Each pillow has a distinct skin which is about an inch in thickness; it is usually non-vesicular and often exhibits a banded struture parallel to the outer surface. The interior of the pillow is vesicular. The vesicles have a roughly concentric arrangement. They increase in size from the border to the centre of the pillows. Usually, they are more numerous in the outermost layers, and decrease in number towards the interior. In many cases, the vesicles nearer the border have an elongated shape like pipe amygdales, their longer axes being disposed in a radial manner. The vesicles are filled in mainly with epidote and so appear dark green in colour.

The pillows are solid to the core and sometimes exhibit concentric bands. Many possess an imperfect radial jointing; gypsum has crystallised often on these joint faces.

The structure of these pillows is very clearly exhibited in weathered outcrops (*vide* Fig. 2). In such cases, the interspaces are usually gouged out and so the pillows are found piled one above the other. The joints and vesicles are also seen to better advantage.

In a previous note it was pointed out that the trap rocks occurring near Chitaldrug show the chemical and petrographical features characteristic of spilitic lavas.[2] The present discovery, therefore, of these pillow structures in this region confirms this conclusion, as spilitic rocks in many parts of the world are subaqueous extrusions.

1. Jayaram, B., "Report on the work done during the field season of 1917–18", *Recs. Mys. Geol. Dept.*, 1922, **18**, 73.

2. Pichamuthu, C. S., "Spilitic rocks from Chitaldrug, Mysore State." *Curr. Sci.*, 1938, **7**, 55–57.

ENDEAVOUR PRIZES

As a contribution to the meeting of the British Association for the Advancement of Science to be held at Birmingham in September 1950, Imperial Chemical Industries Limited, publishers of the quarterly scientific review *Endeavour*, have offered the sum of 85 guineas to be awarded as prizes for essays submitted on a scientific subject. As the primary purpose of these awards is to stimulate younger scientists to take an interest in the work of the British Association and to raise the literary standard of scientific writing, the competition is restricted to those who are not more than 25 years of age on 25th June, 1950. Three prizes will be awarded: a first Prize of 50 guineas, a second Prize of 25 guineas, and a third Prize of 10 guineas. The subjects for the essays are as follows:

1. Modern Techniques in Astrophysics. 2. Phenomena at Low Temperatures. 3. The Literature of Science. 4. Radioactive Tracers. 5. Matallic Corrosion. 6. Macro-molecules. 7. The History and Significance of Common Salt. 8. The Scientific Method. 9. The Mechanism of Heredity. 10. The Biological Significance of Trace Elements. 11. Industrial Applications of Biology. 12. The Earth's Crust.

The essays, which must be in English and typewritten, should not exceed 4000 words in length, and only one entry is permitted from each competitor.

All entries should be addressed to: The Assistant Secretary, British Association for the Advancement of the Science, Burlington House, Piccadilly, London, W.1 and the envelope should be clearly marked '*Endeavour* Prize essay'. The latest date for receipt of entries is 26th June 1950. The essays will be judged by the editors of *Endeavour* in consultation with representatives of the British Association, and the prizes will be awarded during the meeting of the British Association in Birmingham in September 1950. The judges' decision is final, and they reserve the right to withold all or any of the prizes should no entries of sufficient merit be received.

The essays should be submitted without signature. The competitor's full name and address and age should be disclosed in a sealed covering letter attached to the essay and addressed to the Assistant Secretary of the British Association, who will acknowledge all entries. The names will not be disclosed to the judges until after the prize-winning essays have been selected.

In judging the results, special attention will be paid to the way in which the subject is approached, and great importance will be attached to literary style. The competitor's age will also be taken into account. The essay winning the first prize will be published in *Advancement of Science* journal of the British Association.

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MULTIVARIATE STATISTICAL DISTRIBUTIONS AND ECONOMIC MACRODYNAMICS

THE general static equilibrium theory of Walras states that in a given stationary population, the tastes of individuals, distribution of the means of production, technical knowledge and the conditions of equilibrium determine the quantities produced and consumed, as well as their prices and the incomes of the individuals. We say that the structure of an economy is determined by the Walrasian system of equations when

$$\sum_{s=1}^{n} a_{rs} x_s = 0, \; r = 1, 2, 3, \ldots\ldots n \qquad (I)$$

But it is more realistic to assume that the variables in the economy are given by the system of equations,

$$\sum_{s=1}^{n} a_r x_s = \eta_r, \; r = 1, 2, 3, \ldots\ldots n \qquad (II)$$

where the η's are random components distributed normally with zero means. Equation (II) defines the economic variables as components of a multivariate normal distribution with the means given by (I).

To test whether there is a structural change in the economy between two given ten year periods, collect observations at various time points in the two periods which can be taken as independent. Calculate the means for the two periods and the combined dispersion matrix. Now the D^2-statistic of Mahalanobis gives a convenient measure of the structural change in the economy between the two periods. A measure of the intra-structural movement is provided by Wishart's distribution

This analysis of the changes in the macro-economic system brings dynamic economics into a line with the analysis of the motion of a system of particles, *viz.*, motion of the centre of gravity and motion about the centre of gravity.

An elaboration of the theory, with illustrations from Indian economic data will soon follow.

Department of Statistics,
University of Bombay, K. S. Rao.
November 29, 1949.

ON THE COOLING CORRECTION IN CALORIMETRY

An idea of the relative contributions of radiation and convection to the heat losses or gains in the laboratory experiments on calorimetry (in which a copper calorimeter is hung inside a bigger copper vessel by means of threads) can be obtained in the following way. For small differences of temperature, the rate of heat loss (which includes radiation and convection) is given by Newton's Law of Cooling. Expressed in symbols, this law is:

$$\frac{dQ}{dt} = K\,(\theta - \theta_0),$$

where 'dQ' is the amount of heat lost in the interval 'dt', 'k' a constant depending upon the nature and extent of the cooling body, the nature and pressure of surrounding gas, the shape, size and nature of any other vessel which surrounds the cooling body. θ & θ_0 are the temperatures of the body & surrounding medium respectively. If 'm' is the mass of the cooling body, 's' its sp. heat, and '$\delta\theta$' the fall in temperature in interval 'δt' in which it has lost heat by an amount 'dQ'

$$dQ = -ms\,\delta\theta$$
$$= K\,(\theta - \theta_0)\,\delta t \qquad (1)$$
$$\text{or } -\frac{\delta\theta}{\delta t}\cdot\frac{ms}{(\theta-\theta_0)} = K \qquad (2)$$

Thus if 'k' is calculated by inserting the value of the rate of fall of temperature $\frac{\delta\theta}{\delta t}$, at a certain temperature θ in 2, the heat loss 'dQ' in an interval 'δt' can be calculated from (1) and if the superficial area of the cooling body be known, the rate of heat loss per unit area is also easily calculated. This gives the *total* heat loss. If the body be assumed to be behaving as a black body, the rate of heat loss due to radiation per unit area from it can be calculated by the Stefan-Boltzmann Law. Thus if its temperature be T°A & T°$_0$A be the temperature of the surroundings, this is given by, $\sigma(T^4 - T_0^4)$ where 'σ' is Stefan's constant. The assumption that the body is behaving like a black body is highly artificial but it gives an upper limit of the heat loss due to radiation. Comparing this value with the one which gives the total heat loss, as calculated above, the relative contribution of radiation is computed. For a small difference of temperature of 5°C. between the body and surroundings, the results of an experiment on the above lines show that the contribution of radiation is 75%. Thus convection is certainly responsible for 25% of heat loss and obviously more than 25%, as the body is not a black body. This dispels the confusion sometimes prevailing that it is radiation which is the all important factor.

Science College, Manoranjan Prasad Gupta.
Patna,
March 19, 1950.

INTENSITY OF RAMAN LINES IN BARYTES

The temperature variations of the intensities of the Stokes and anti-Stokes Raman lines in barytes have been investigated by the author. The method of intensity measurements adopted has been described in a previous communication.[1] All the Stokes lines, lattice as well as internal, were found to decrease in intensity with rise of temperature while the anti-Stokes line corresponding to 73·6 cm.$^{-1}$, 462 cm.$^{-1}$, and 988 cm.$^{-1}$, showed a conspicuous increase with the rise of temperature. The relative intensities for the 988 line are listed in Table I and the S/A.S. ratio for the 73·6 cm.$^{-1}$ line in Table II.

Table I

Temperature	Stokes 988 cm.$^{-1}$		Temperature	Anti-Stokes 988 cm.$^{-1}$	
	Observed	Calculated		Observed	Calculated
300° K.	1	1	300°	1	1
427°	·84	1·03	363	1·3	2·3
517°	·79	1·06	427	2·2	4·2
525°	·7	1·09			

Table II

Ratio S/ A.S. 73·6 cm.$^{-1}$ Raman line

Temperature	$e^{\frac{h\nu_s}{kT}}$	$\left(\frac{\nu-\nu_s}{\nu+\nu_s}\right)^4 e^{\frac{h\nu_s}{kT}}$	Observed value
300° K.	1·42	1·40	1·35
427	1·28	1·26	1·25
517	1·23	1·21	1·20
595	1·19	1·18	1·15

There is a decrease in intensity of the Stokes lines instead of the theoretically[2] expected increase and the anti-Stokes increases with rise of temperature but to a smaller extent. In the case of $C Cl_4$ such a discrepancy has been explained as being due to the anharmonicity introduced by centrifugal force due to rotation.[3] In the other cases that have been studied it has been attributed to the expansion of the series polarizability α as $\alpha_0 + \Sigma \left(\frac{\partial \alpha}{\partial q}\right)_0 q + \ldots$ by Taylor being not valid for large values of q.[4] This latter explanation is not correct as the Taylor series expansion must be true though there is a dependency of $\left(\frac{\partial \alpha}{\partial q}\right)_0$ on temperature as a result of anharmonicity. Even when an attempt is made to take into account this anharmonicity by using the wavefunction obtained from the Morse function instead of that of a simple harmonic oscillator, the intensity of the Stokes line should only increase though to a different extent, with rise of temperature. So in an actual case, if it is assumed that the scattering from molecules in the higher states is not much more than those in the lower states and that transitions involved in the formation of the Stokes line are less probable than those in the case of the anti-Stokes line, we can understand the observed decrease in intensity of the Stokes line with the rise of temperature.

Physics Department,
Indian Institute of Sci., P. S. NARAYANAN.
Bangalore-3,
March 22, 1950.

1. Placzek, *Zeits. fur. Phys.*, 1931, **70**, 84. 2. Narayanan, P. S., *Proc. Ind. Acad.*, A, 1948, **28**, 463. 3. Anantha Krishnan, R., *Ibid.*, A, 1938, **7**, 196. 4. Venkateswaralu, K., *Nature*, 1947, **159**, 96. 5. Morse, *Physical Review*, 1929, **34**, 57. 6. Dunham, T. L., *Ibid.*, 1929, **34**, 438. 7. Bhagavantam, *Proc. Ind. Acad.*, 1938, **10**, 224.

ABSORPTION SPECTRA OF TELLURIDES OF ANTIMONY AND BISMUTH

THE author has studied the absorption spectra of SbTe and BiTe molecules in the vapour state at high temperatures using a graphite electric furnace. None of these molecules has been studied previously, either in emission or in absorption. Several band systems have been observed and studied in detail. The band-heads have been measured and the band systems analysed. The following table gives the various band systems observed and the values of the molecular constants deduced from the vibrational analysis of these systems.

TABLE I

Molecule	System	Region in A U.	Molecular constants r_e	ω_e''	$\omega_e''\chi_e''$	ω_e'	$\omega_e'\chi_e'$
SbTe	I	2383-2260	43553	284·4	0·20	314·50	0·48
BiTe	I	2942-2814	..	208·5	0·52	..	..
BiTe	II	2454-2382	..	208·5	0·52	..	..
BiTe	III	2390-2315	42870	208·5	0·52	164·40	0·12
BiTe	IV	2374-2279	43116	208·5	0·52	263·00	0·96
BiTe	V	2276-2200	..	208·5	0·52	..	..

For all these band systems analysed Condon parabolæ have been drawn. These, in general, are narrow as would be expected from the nearness of ω_e'' and ω_e' values.

In some of these measurements the absorption bands of the metals Sb_2 or Bi_2, also appeared prominently. These spectra however, are easily identified since they are well known from the detailed studies of Nakamura and Shidie, Almy and Sparks. Fortunately they do not overlap with the spectra of the SbTe or BiTe molecule and hence do not interfere with the present measurements.

The author wishes to express his thanks to Sir K. S. Krishnan, F.R.S. under whose supervision the work was done.

Physics Department, C. B. SHARMA.
Lucknow University,
Lucknow,
March 13, 1950.

ABSORPTION SPECTRA OF ANTIMONY AND BISMUTH SELINIDES

THE absorption spectra of SbSe and BiSe have been studied in the vapour state at high temperatures using a graphite electric furnace. None of these molecules has been studied previously either in emission or in absorption. Several band systems have been observed and studied in detail by the author. The band-heads have been measured and the band systems analysed. The following table gives the various band systems observed and the value of the molecular constants deduced from the vibrational analysis of these systems.

For all the band systems analysed Condon parabolæ have been drawn. These, in general, are narrow as could be expected from the nearness of ω_e'' and ω_e' values.

TABLE I

Molecule	System	Region in A.U.	Molecular Constants				
			ν_e	ω_e''	$\omega_e''x_e''$	ω_e'	$\omega_e'x_e'$
SbSe	I	3685–3289	28965·0	326·1	1·04	221·80	1·00
SbSe	II	2870–2620	36041·0	326·1	1·04	418·90	0·48
SbSe	III	2456–2360	..	326·1	1·04	..	..
SbSe	IV	2335–2222	43756·0	326·1	1·04	365·74	0·76
BiSe	I	2900–2700	35617·5	264·7	0·40	304·00	2·00
BiSe	II	2350–2200	44425·0	264·7	0·40	316·00	2·00

In some of these measurements the absorption bands of the metals Sb_2 or Bi_2 also appeared prominently. These spectra, however, are easily inentified since they are well-known from the detailed studies of Nakamura and Shidie, Almy and Sparks. Fortunately they do not overlap with the spectra of SbSe and BiSe and hence do not interfere with the present measurement.

The author wishes to express his thanks to Sir K. S. Krishnan, F.R.S., under whose supervision the work was done.

Physics Dept., C. B. SHARMA.
Lucknow University,
February 28, 1950.

A THEORETICAL EXPLANATION OF THE JOSHI-EFFECT

THE Joshi-Effect may be summed up as follows: A gas is contained between the plates of a condenser across which a low frequency alternating p.d. is applied. The current passing through the gas is recorded. If now the gas is irradiated with continuous visible light a fall in the current conducted through the gas amounting to 50-80% or even 90-95% is recorded. This is called the Negative Joshi-Effect. A few cases have been found in which the current is found to increase instead of decreasing. This is called the Positive Joshi-Effect.

First we shall take up the Negative Joshi-Effect. The underlying idea of the theory developed here is that: (1) when the gas is not exposed to light, the ions responsible for conduction of current possess a certain mobility, (2) when the gas is exposed to light, ions and/or neutral particles become excited due to absorption of light and their outermost electron occupies a higher orbit, (3) occupation of a higher orbit by the electorons means a large increase in diameter of the ions and/or neutral particles and therefore a still large decrease in their mean free-path, (4) this decrease in mean free-path leads to a corresponding decrease in the mobility of the ions, and hence also a decrease in the current.

Consider a simple hydrogen-like ion having a positive core of charge Ze which influences the electron in the outermost shell of the ion. The radius a of the Bohr orbit of the electron will be given by

$$a = \frac{h^2n^2}{4\pi^2me^2Z} \qquad (1)$$

where m = mass of electron, e = the charge of the electron, h = the Planck's constant and n is the quantum number of the orbit.* Now λ, the mean free-path of a particle, is given by

$$\lambda = \frac{1}{\sqrt{2}\,\pi n_0\,\sigma^2} \qquad (2)$$

where n = the number of particles per unit volume and σ = the diameter of the particle $= 3a$. Therefore on substituting† from (1) into (2)

$$\lambda = \frac{2\sqrt{2}\,\pi^3m^2e^4Z^2}{n_0h^4} \cdot \frac{1}{n^4}$$
$$= K/n^4, \text{ where K is a constant} \qquad (3)$$

Now mobility of an ion is given by (see Crowther)‡

$$\text{mobility} = \tfrac{1}{2} \cdot \frac{e}{m} \cdot \frac{\lambda}{V} \qquad (4)$$

where V = the velocity of thermal agitation, and, is therefore a constant at the room temperature.

From (3) and (4)

$$\text{mobility} = \tfrac{1}{2} \cdot \frac{e}{m} \cdot \frac{K}{V} \cdot \frac{1}{n^4}$$
$$= C/n^4 \qquad (5)$$

where C = a constant at a constant temperature. Current passing through the gas is proportional to the mobility. Hence

Current $= a/n^4$, where a is a constant....(6)

Thus we see that the current varies inversely as the fourth power of the quantum number of the orbit the outermost electron occupies.

Thus if the electron goes from first orbit to second orbit the current due to the ion will be reduced in the ratio of 16:1; if it goes from second orbit to third the current will be reduced in the ratio of 81:16, i.e., 5: 1. This explains the Negative Joshi-Effect.

Positive Joshi-Effect: If due to the action of the alternating p.d. the ion is already in an excited state, such that transitions to the lower states are forbidden, then on exposure to light it may pass over to a higher state from which transitions to the lower states are allowed, and hence the ion may go to the lower states. A little consideration will show that on the whole in this process there will be an increase in current. For example, suppose that the ion is already in the state 2 and transition to state 1 is forbidden, and it passes to state 3 on exposure to light and then returns to state 1. Equation (6) gives the initial, intermediate and final currents as $\frac{a}{16}$, $\frac{a}{81}$ and $\frac{a}{1}$. The mean of the last two may be roughly considered to be the effective current on exposing to light. This is about $\frac{a}{2}$ and is evidently greater than the initial current $\frac{a}{16}$. Thus, under suitable conditions Positive Joshi-Effect may be observed for some substances.

With the same substance under different conditions (*e.g.*, variations in frequency, the value of the alternating p.d. and the pressure of the gas used) both Positive and Negative Joshi-Effect may be observed, when there is a high probability for the ions to pass to a higher state from which transition to lower states is forbidden.

The author is thankful to Dr. K. Majumdar for valuable discussions.

Physics Dept., Allahabad University, *December* 20, 1949. SATYA NARAIN GARG.

* For more complicated atoms and for molecules this formula has to be modified, but it is evident that the size of the ion will increase with n.

† Here the effect of charge and the difference in the diameter of other particles has been neglected, the theory outlined being only rough.

‡ J. A. Crowther, Ions, Electrons and Ionizing Radiations; Seventh Edition, pp. 27–28.

DIELECTRIC CONSTANTS AND ELASTIC MODULI OF UNIAXIAL CRYSTALS

WHILE trying to account for the higher value of the dielectric constant parallel to the optic axis than in the perpendicular direction of alumina (an optically negative crystal), an interesting similarity between dielectric constants and elastic moduli of uniaxial crystals disclosed itself. The constants of different crystals are given in the table.

Crystal	Dielectric constants		Elastic moduli		
	K_{11}	K_1	$s_{11} \times 10^{13}$	$s_{33} \times 10^{13}$	Investigator
Calcite ..	8·2	8·7	11·0	17·3	Bhimasenachar
Apatite ..	8·6	10·2	6·1	10·88	"
Beryl ..	6·8	7·6	4·42	4·70	Voigt[2]
Tourmaline (transparent)	6·0	7·4	3·98	6·24	"
Alumina ..	11·8	9·5	2·84	2·21	Sundara Rao[3]
Quartz ..	4·6	4·45	13·0	9·90	Voigt[2]

(The dielectric constants are those determined by the author.)

It can be seen from the Table that the dielectric constant is higher in the direction in which the modulus giving the contraction is smaller. Wooster[4] pointed out that linear compressibility in a direction parallel to the plane of the carbonate or nitrate ions of calcite or sodium nitrate is smaller because of the greater binding strength in that plane. This is indicative of close packing of ions and hence the dielectric constant can be expected to be higher for any direction in that plane. It is seen that, in all other uniaxial crystals as well for which elastic and dielectric data is available, the direction of higher dielectric constant coincides with the direction of smaller modulus of elasticity or of greater binding strength. Thus the higher dielectric constant of alumina in the parallel direction is in conformity with the observed smaller modulus of contraction in that direction. It is reported[5] that magnesium carbonate shows the same anomaly of having a higher dielectric constant in the direction for which the refractive index is lower and it will be interesting to examine its dielectric constants in relation to the elastic moduli. But unfortunately data on the elastic constants of magnesium carbonate are not available.

Physics Dept, Andhra University, Waltair, *March* 14, 1950. D. A. A. S. NARAYANA RAO.

1. Bhimasenachar, *Proc. Ind. Acad. Sci.*, A, 1945, **22**, 199. 2. Voigt *Lehrbuch der Kristall Physik.*, reprinted 1928, 748–753. 3. Sundara Rao, *Proc. Ind. Acad. Sci.*, A, 1949, **29**, 352. 4. Wooster, *Crystal Physics.*, 1938, **269**. 5. Errera and Brasseur, *Phys. Zeit.*, 1933, **34**, 368.

PECULIARITIES IN THE HORIZONTAL WIND FLOW AT THE VIZAG AIRFIELD

CIVIL pilots have often reported to the senior author, that they experience vigorous bumpiness in the neighbourhood of the hilly approaches to the Vizagapatam airfield (Fig. 1), while landing and taking off. A scrutiny of the pilot balloon working sheets at Vizag on such days revealed a consistently unusual distribution of the wind velocity in the lower levels of the atmosphere. It was therefore of interest to investigate the influence of the orographic features at Vizagapatam on the upper winds in the lower levels of the atmosphere.

As the transitional month of October affords winds from all points of the compass, the data of 73 pilot balloon ascents in October 1949 at the Vizag airfield were studied. The anomaly in the velocity distribution was in the shape of a sudden dip in the velocity curve in the lower levels, as illustrated by the typical height-velocity curves reproduced in Fig. 2. This peculiarity cannot be due to non-uniformity in the rate of vertical ascent of the balloon, as this rate is a function of the buoyancy of the balloon due to density contrast.

The ratio of the minimum wind velocity

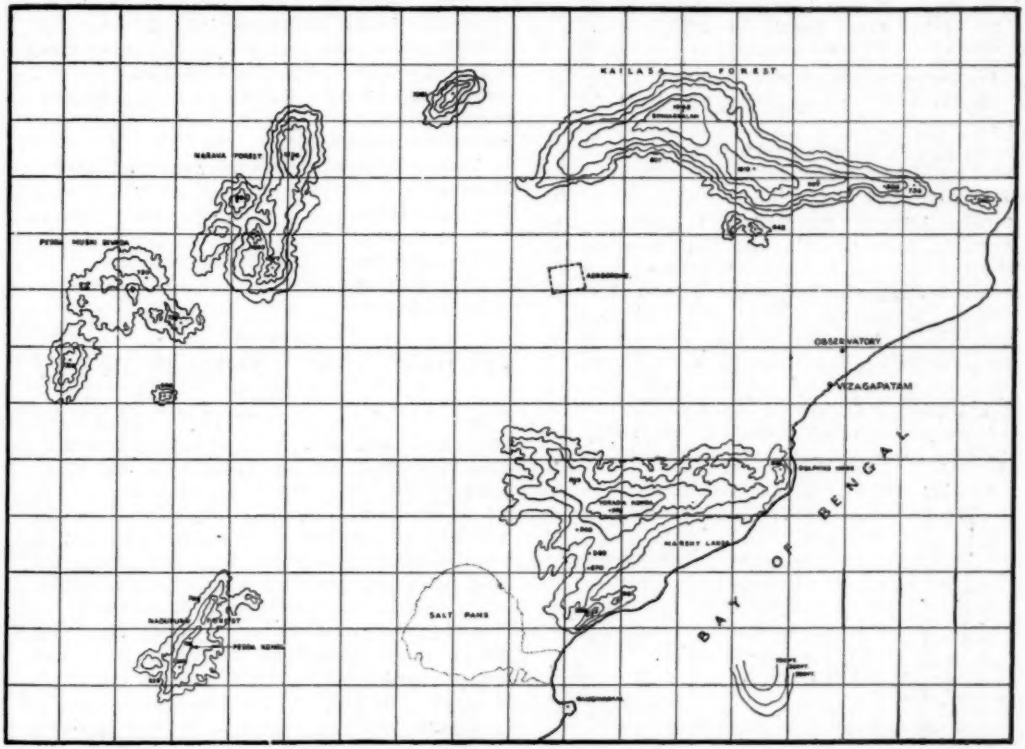


FIG. 1. Topographic Map of the Vizagapatam Airfield.

reached to that just before its fall has been worked out as a percentage on each of the 73 occasions studied. In Table I are given the principal results of this investigation on occasions when the wind blew from the airfield towards the surrounding hills and plains.

The data showed that when the wind blew from the airfield towards Simhachalam and Yeradakonda there were respectively 97% and 88% of occasions of sizable velocity reduction of more than 20%. Winds blowing into the south-west sector, which is practically plain show a velocity drop only on 2 out of 13 occasions. On one of these, the fall was only by 29%; on the other, the balloon may have got

TABLE I

Wind sector from airfield	Towards	No. of occasions of velocity reduction			
		Less than 20%		More than 20%	
155–260°	Simhachalam	1	3%	30	97%
261–313°	Bay of Bengal	1	25%	3	75%
314–024°	Yeradakonda	1	12%	7	88%
025–076°	SW plains	13	86%	2	14%
077–123°	Narava	4	33%	8	67%
124–154°	NW plains	2	67%	1	33%

entangled in some perturbation in the wind field not traceable to orography. Three of the 4 occasions of the wind blowing from the airfield towards the Bay of Bengal were of sensible velocity fall. The wind directions in these 3 cases lie in the close proximity of the eastern ends of Simhachalam and Yeradakonda. Extension of frictional effects near these hills towards the Bay appears to be responsible for the origin of these anomalies. It may therefore be inferred that vigorous turbulence is generated in the neighbourhood of the principal hill ranges at the Vizag airfield by winds blowing towards them.

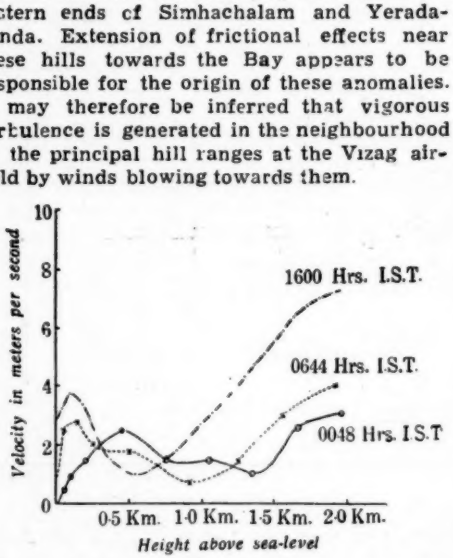


FIG. 2. Typical curves of the velocity distribution in the lower levels of the atmosphere on 22-10-1949.

An examination of the data of the winds blowing from across the hills and valleys towards the airfield showed that on 86% of the occasions of the winds from Simhachalam blowing towards the Yeradakonda across the airfield and 91% of the occasions of the winds from Yeradakonda blowing across the airfield towards Simhachalam there was considerable velocity dip. Again, 86% of the cases of the winds from the sector 026-075°, i.e., from Simhachalam across the airfield into the SW plains were of negligible or no velocity fall. The frictional effects on the leeward side of these hills do not thus appear to extend up to the airfield. The winds from the SW plains, Narava and the NW plains carry the released balloon into the windward eddies of the principal hill ranges and it was found that on 96 to 100% of these occasions the velocity curve registered a steep fall in the lower levels.

A similar investigation carried out in regard to the pilot balloon data of the Maharanipetta Observatory near the coast at Vizag led to very similar results. Details will be published elsewhere.

Meteorological Office,
St. Thomas' Mount, D. VENKATESWARA RAO.
Madras,
July 25, 1949,
and
Met. Observatory, K. RAGHAVAN.
Civil Aerodrome,
Coimbatore.

SUCTION AND COMPRESSION BY LUNGS

THE action of human lungs in sucking in or forcing out air can be very well compared with that of an ordinary air pump and the usual formula, for the density or pressure of air in the receiver of an air pump, after a certain number of strokes of the piston, should be applicable in the case of the lungs also. To test this point, the following simple experiment was carried out in this Laboratory.

A long narrow glass tube is fixed vertically into a large trough of water its upper end being connected by a thick rubber tubing to a small piece of a vertical glass tube L provided with a stopcock N and passing through a hard rubber cork into a large flask S.

A similar piece of another vertical glass tube M also passes through the rubber cork and communicates with the air in the flask S. The outer end of the tube M is connected to a rubber tube K provided with a pinch cock C. Keeping the cocks C and N open, air is sucked in by mouth through K from the flask S. This causes water to rise from the trough A upto a certain height h_1 in the tube T. As soon as one complete suck is over, the cocks N and C are closed so that the water level h_1 reached during the first suck is maintained constant and can be accurately determined. For the next operation, after applying the mouth to the outer end of the tube K, the cock C is opened and air is sucked in

from S, simultaneously opening the stop-cock N. This causes the water to rise to a higher level h_2 in the tube T. This level h_2 reached during the second suck and maintained constant when the cocks N and C are closed, is again noted. This process is then repeated several times until no appreciable rise of water is caused in the tube T by any further sucking of air from S. The water levels $h_1, h_2, \ldots h_r, \ldots h_\infty$ corresponding to the serial number (r) $(r=1, 2, \ldots \infty)$ of the air sucks are carefully noted, h_∞ denoting the level reached at the end of the last suck.

In the analogous case of an air pump, if V is the volume of the vessel (receiver) from which air is being pumped out and if the volume of the barrel varies from u to v $(u>v)$, it can be easily shown that under isothermal conditions, the pressure p_r in the vessel after r complete strokes of the piston in given by:—

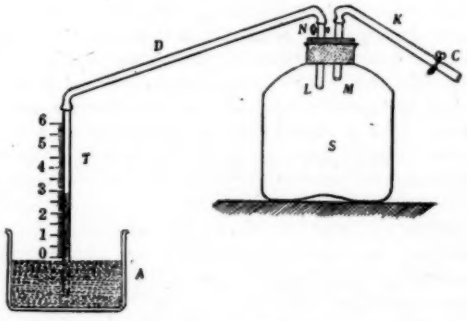
$$p_r = P - \left(\frac{V}{V+u}\right)^r (P-\pi) \qquad (1)$$

where π is the atmospheric pressure and $P(=\pi v/u)$ is the lowest pressure attainable with the pump. We may put $P=p_\infty$. Now during any particular experiment of this type $(\pi - p_\infty)$, where $(p_\infty = \pi - h_\infty)$, remains constant and for the person doing the experiment, $(V/V+u)$ is also constant. Hence (1) can be expressed as:

$$\log(h_\infty - h_r) = kr + k' \qquad (2)$$

where k and k' are constants and $p_r = (\pi - h_r)$.

It is found that in all cases, the graph of $\log(h_\infty - h_r)$ against r comes out to be a straight line.



By a slight modification of the above experiment, lungs were used to compress air in the big flask and the consequent rise of water in a long glass tube fixed in a smaller flask of water, was noted for different compressions. Results, similar to those of the first experiment, were obtained in this case also, indicating the physical similarity between lungs and air pumps. Details of these experiments will shortly be published elsewhere.

Our thanks are due to Dr. D. S. Kothari, Scientific Adviser to the Ministry of Defence, New Delhi, for suggesting this problem.

Physics Department, D. V. Gogate
M. S. University of Baroda, G. Z. Shah.
January, 31, 1950.

DIELECTRIC CONSTANTS OF ALUMINA

The author[1] previously reported the dielectric constants parallel and perpendicular to the optic axis of naturally occurring opaque corundum crystals. It was found that the parallel value was greater than the perpendicular value. This observation is not in agreement with that of Fellinger[2] and is also unusual as generally for uniaxial crystals the dielectric constant is higher in the direction in which the refractive index is higher. So to confirm those values, a transparent variety of the same crystal has now been studied. Sections from an artificially grown, perfectly transparent alumina crystal are used and the dielectric constants are determined by the liquid-mixture method[3] at a frequency of 1·6 megacycles. The following values are obtained.

$$K_{\parallel} = 11{\cdot}8 \quad \text{and} \quad K_{\perp} = 9{\cdot}5$$

$K_{\parallel}$ for the synthetic crystal is somewhat larger than the corresponding value for the natural opaque crystal, whereas $K_{\perp}$ is nearly the same. Fellinger[2] reported $K_{\parallel} = 11{\cdot}03$ and $K_{\perp} = 12{\cdot}80$ for synthetic sapphire and his values are not supported by the author's observations.

The author wishes to express his thanks to Prof. R. S. Krishnan for the kind loan of the crystal sections.

Dept. of Physics, D. A. A. S. Narayana Rao.
Andhra University,
Waltair,
March, 14, 1950.

1. Narayana Rao, *Proc. Ind. Acad. Sci.*, A, 1941, **30**, 82. 2. Fellinger, *Ann. d. Phys.*, 1919, **60**, 181. 3. Narayana Rao, *Proc. Ind. Acad. Sci.*, A, 1947, **25**, 408.

ON THE CONSTRUCTION OF METAL G.M. COUNTERS*

The present note describes the constructional details and characteristics of Metal G.M.

*(The work was done in the Delhi University Physics Laboratory, Delhi, India).

Counters (Fig. 1) so commonly used in Cosmic Ray and Nuclear Physics Research.

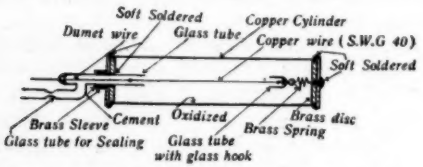


FIG. 1. Showing a Complete Metal Counter.

A seamless copper tube of about ·5 mm. thick is closed at the ends by means of ⅛ inch thick brass discs with holes of suitable diameter at the centre of each. Before assembling the counter the inside of the tube is well polished and cleaned properly with nitric acid. The cylinder and the end discs are thoroughly degassed at about 400° C for 2-3 hours, after which the cylinder is uniformally oxidized by heating it over a flame. An ordinary glass tube of about 5 mm. diameter and 1 mm. wall thickness (though it is not critical) is taken and a band of silver fused on it. This is done by putting some AgCl at the desired portion and heating it gently in a blow-pipe flame till a light layer of silver fused into the glass tube is obtained. A thin layer of copper is then deposited over the silver by ordinary electroplating. (Both chemical silvering and graphite layers have a tendency to peel off in flakes and should not be used. The above process, however, gives a very hard sticking layer). The tube is soldered to the brass disc at the plated portion by applying ordinary solder and it is found that it is as easy to solder this glass tube to brass disc as it is to solder two metal pieces. A small piece of dumet wire is sealed at one end of the glass tube to which is joined a side tube for filling the counter and sealing. One end of the central wire (copper, S.W.G. 40) is connected to the dumet lead and the other end is similarly connected and a brass spring attached to a glass hook placed as shown. The glass tubes also serve as sleeves and shield the ends which thus eliminate the possibility of local high fields. The two end discs are then soldered in position. A small space round the glass tube is filled with a cement (MgO + sodium silicate) which gives an additional strength to the glass-metal soldered joint. Finally the counter is washed with alcohol to remove any contaminations and a good coat of lacquer applied on the whole of the outer surface to remove any possible diffusion leak. It is then filled with commercial argon (8·5 cm.) and alcohol (100% pure) 1·5 cm. to a total pressure of 10 cm. of Hg. and sealed. Fig. 2 gives the counting rate-voltage curve of a typical counter. The tube shows a considerably long plateau (525 volts) with small plateau slope (·04% per volt).

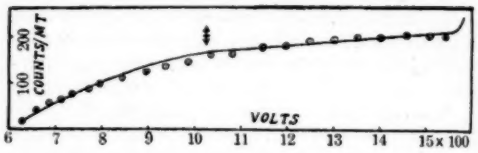


FIG. 2. Plateau curve for the Metal Counter. Arrow indicates the extent of the error in counts.

Due to its better qualities, ease of construction and low cost it is felt that the details will be of some help to workers in this field.

The author is grateful to Dr. P. L. Kapur, Reader in Physics, Delhi University, Delhi, for providing facilities for this work and for his interest throughout its progress; and to Mr. S. K. Suri, M.Sc., of the N.P.L. for helping in the initial stages of the work.

E.P.U. Physics Dept., OM PRAKASH.
Government College,
Hoshiarpur. E.P. (India),
March 6, 1950.

POTASH-FIXING CAPACITY OF ALLUVIAL SOILS

HAUSER[1] found that Dutch soils containing mica minerals possess the greatest potash-fixing capacity. Seatz and Winters[5] got similar results with micaceous soils. They suggested that the exchangeable potash remained in equilibrium with potassic soil minerals and that when the degree of potash saturation of the colloids s altered by manuring and cropping, it tends to be fixed or released respectively. The potash-fixing capacity of micaceous soils found here by Pathak, Mukerji and Shrikhande[4] was determined to test the truth of Hauser's observations.

Potash-fixing capacity of manured and unmanured soils as affected by continuous cropping was studied, and a few important data are given below.

Apprehending that organic matter may interfere in the process of potash-fixation (*cf.* Joffe and Levine *et al.*) it was destroyed in these soils by hydrogen peroxide treatment. The hydrogen peroxide treated soil was found to be invariably greater in potash-fixing capacity in both the manured and unmanured samples than the original soil,

Potash-fixing capacity of alluvial soils at different depths in both manured and unmanured plots

	0–6" mgm. %	6"–1' mgm. %	1'–2' mgm. %	Mean mgm. %	0–6" mgm. %	6"–1' mgm. %	1'–2' mgm. %	Mean mgm. %
	MANURED				UNMANURED			
Soil ..	1·27	1·66	3·43	2·12	2·31	1·64	2·85	2·27
H_2O_2 treated Soil ..	2·09	2·24	3·82	3·05	2·96	2·06	3·08	2·70
Depression in K_2O fixing capacity due to organic matter ..	−0·82	−0·58	−0·39	−0·59	−0·66	−0·42	−0·23	−0·44
Sand fraction ..	0·26	0·22	0·30	0·26	0·37	0·31	0·31	0·33
Silt fraction ..	8·77	4·73	7·17	6·89	10·70	3·96	5·04	6·56
Clay fraction ..	4·63	7·56	8·79	6·99	5·29	7·29	8·92	7·16

proving Joffe[2] and Martin's[3] observation that organic matter reduces the potash fixed by the soil. The potash fixed increased with depth; the reason is not clear and is being investigated.

Potash-fixing capacity of sand was found to be very small in both manured and unmanured soils; the sand fraction in the unmanured soil had greater potash-fixing capacity than the corresponding fraction in the manured one. This contrast is greatest in the first six inches.

The silt fraction of the soil has a large potash-fixing capacity and is on the average 6·89 mgm. percent for the manured and 6·56 mgm. per cent. for the unmanured. It is highest on the top and decreases in the middle layer, potash-fixing capacity being greater in the top layer of the unmanured soil than in the manured.

Clay on an average has potash-fixing capacity of 6·99 mgm. per cent. for manured and 7·16 mgm. percent for unmanured soils. The potash-fixing capacity increased with depth. Clay in both manured and unmanured has the same potash-fixing capacity.

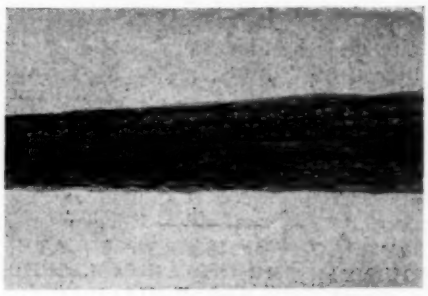
The surface six inches of unmanured soil thus appears to have developed a considerable amount of potash-fixing capacity due to continuous cropping of wheat which probably may be one of the reasons for obtaining a low but steady wheat yield year after year.

Chemistry Section, A. N. PATHAK.
Govt. Agric. College, J. G. SHRIKHANDE.
Kanpur, S. K. MUKERJI.
February 3, 1950.

1. Thesis by Wageningen, 1941, 171. 2. *Soil. Sci.*, 1947, **63**, 241-247. 3. *Proc. Soil. Sci. Soc. Amer.*, 1945, **10**, 1946, 94-101. 4. *Curr. Sci.*, 1949, **18**, 375. 5. *Proc. Soil. Sci. Soc. Amer.*, 1943, **8**, 1944, 150-53.

A NEW RECORD OF *PUCCINIA* ON SUGARCANE IN BOMBAY

A SERIOUS outbreak of rust on sugarcane (*Saccharum officinarum*), causing extensive damage was reported from the Deccan Canal tract during September-October, 1949. A survey undertaken in the area showed that the rust is prevalent at Belapur, Kopergaon, Belwandi, Ahmednagar, Baramati, Akluj and other canal tracts and was causing serious damage to Co. 475 cane alone, while the other varieties were free from infection. The rust which is caused by a sp. of *Puccinia*, is confined to the leaves and is now being studied in detail. Fig. 1 shows the typical symptoms of



the disease. Casual survey of the affected area showed that infection was heavy, amounting to 50% and over. The crop was three to five months old. The rust has not so far been reported from the other tracts of the Bombay State.

The uredial stage of *Puccinia kuehnii* Butler appears to be quite common on a number of wild *Saccharums* such as *S. arundinaceum*, *S. narenga*, *S. spontaneum*, *Sclerostachya fuscum* in India, Hawaii, Cuba, Java, Australia, West Indies, U.S.A., Philippines, Japan, etc. Butler,

however, discovered the telial stage of this rust on *S. spontaneum* from Burma. This, therefore, is the first record of telial stage on cultivated sugarcane (*S. officinarum*). Inoculation experiments carried out in this laboratory have shown that while it can readily infect Co. 475 of *S. officinarum*, it does not infect *Sorghum vulgare*.

The measurements of uredio aad teliospores show the following range:—

Spores	Range	Mean
Urediospores	32·2–62·6×21·7–41·7	43·3×30·8 μ
Teliospores	32·0–85·5×16·2–37·1	51·0×26·4 μ

While the general characters and description of the spore-forms are similar to those reported by Butler[1] for *P. kuehnii*, the size of teliospores obtained from *S. officinarum* (Co. 475) is much larger than that reported by Butler on *S. spontaneum*. The rust is probably a new species and it is proposed to name it *Puccinia sacchari*. Whereas the telial stage of *Puccinia kuehnii* occurs only rarely, it is very common in this species collected by us. Further work is in progress.

It may also be stated that Co. 475, a very promising variety of sugarcane, is also highly susceptible to whip smut caused by *Ustilago scitaminea* Syd., which is generally absent in other varieties of sugarcane grown in Bombay State.

Plant Pathological Lab. M. K. PATEL.
College of Agriculture, M. N. KAMAT.
Poona 5, Y. A. PADHYE.
March 16, 1950.

1. Butler, E. J., Fungi and Diseases in Plants, Thacker Spink & Co., Calcutta, 918.

A CALONYMPHID FLAGELLATE FOUND IN THE INDIAN MILLIPEDE, THYROPYGUS (FAM. HARPAGOPHORIDAE)

THIS is presumably the first record of a flagellate of this kind to be found in the intestinal contents of a millipede. The junior author prepared the smears, by fixing them with Bouin's fluid and staining them with Heidenhain's iron-hematoxylin. Differentiation of the nuclear material was made easy by using saturated picric acid solution.

Metastephanonympha karnataki n. sp.

The form of the parasite is more or less oval, with the posterior pole somewhat pointed. The outline of the ectosarc is very faint and the whole endosarc is parasitised by hundreds of rod-like bacteria, about 5 to 7 microns long and disposed in longitudinal rows. Such bacteria are also seen free around the flagellate.

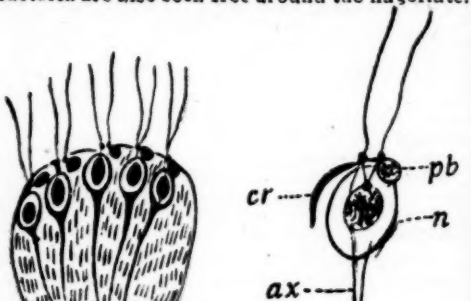


FIG. 1. Calonymphid with 5 mastigonts.

FIG. 2. Structure of a mastigont: *cr* = cresta; *pb* = parabasal; *n* = nucleus with its endosome; *ax* = axostyle.

The nuclei of the mastigonts lie in a row close to the outer membrane. The number of the nuclei recorded in 25 individuals is as under:—

No. of Nuclei ..	2	3	4	5	6	7	8	12
Number of parasites ..	2	1	2	6	3	5	5	1

The nuclear endosome is concentrated in a more or less oval mass surrounded by a clear halo bordered by the nuclear membrane. In the anterior pole of the endosome a centriole is connected by two rhyzoplasts to two very distinct basal granules from which emerge two flagella, one from each granule. Beside the flagella, the following organels are noticed:—

One of the basal granules gives rise to a curved or rod-like *cresta* and the axostyle which starts as a fine filament crosses the nuclear region and seems to widen a little in the posterior pole of the nuclear membrane, tapering downwards as a filament which stops more or less in the middle region of the body. The axostyles do not collect themselves in a bundle but are nearly lost in the endoplasm as individual units. To the other basal granule is attached a small oval or sacciform *parabasal* similar to that found in the genus *Stephanonympha*.

These two basal granules often very close to each other are in fact interconnected by a

transverse rhyzoplast. The connecting fibrils described as rhyzoplasts are very difficult to detect since they occur in a considerably small area.

Measurements in microns taken in 9 individuals gave:— 34/23; 23/18; 28/20; 28/18; 20/20; 16/16; 13/13; 12/10; (length/breadth), Nucleus 3½ to 4; flagella 5 to 6 microns.

Classification

In the family Calonymphidœ Grassi, the genus *Calonympha* possesses only one flagellum in each mastigont. The *Stephanonympha* has four flagella in each mastigont; and the *Diplonympha* has only two nuclei are disposed in two plans, one superficial and the other more deeply imbedded in the endoplasm. The parasite belongs to the genus *Metastephanonympha* DeMello and Brito (1929), which has two flagella. The type species, *M. perrouciti* parasite of *Coptotermis heimi*, has more or less a rounded posterior end. Moreover the axostyles anastomose forming a bundle at the posterior pole and the structure of the mastigont especially the cresta is quite different. The flagellate is distinctly a new species which we will name *Metastephanonympha karnataki* n. sp.

We express our thanks to Dr. S. L. Hora, Director, Zoological Survey of India, Calcutta, for getting the millipede identified.

Nova Goa and Dept. of Zoology, Karnatak College, Dharwar,
January 25, 1950.

Col. I. Froilano DeMello.
J. C. Uttangi.

1. DeMello, I. F., and Julio Brito, 1929, "Sur un Calonymphide parasite d'un Termite indien," (*Compt. Rend. Soc. Biologie*). 2 "*Metastephanonympha perrouciti* n. gen. n. sp., Calonymphide parasite de' intestin d'un termite de Damão" (*Arg. Esc. Med. Cirurgica de Nova Goa*, Scries A, 1929.

SECONDARY INFECTION IN THE BAJRA SMUT DISEASE CAUSED BY *TOLYPOSPORIUM PENICILLARIAE* BREF

Fresh spores of *Tolyposporium penicillariæ* collected from a crop sown early at the Institute farm gave very good infection in Bajra ears inoculated while they were very young and still enclosed in the sheath-leaves. Inoculation was made by first removing the sheath leaf in each case and then smearing the spore-balls by means of a brush observing the usual precautions. Ajrekar and Likhite[1] have observed that "no resting period is necessary for the spore-balls to germinate, *at least on artificial media*" (italics ours). Our expriments confirm that the spore-balls do not have any dormant period and that they can germinate immediately even on the host and cause infection.

As the fungus can immediately infect its host, and as the incubation period is only about two weeks, secondary infection in a later-sown crop or in ears emerging late may occur. Observations on the frequency of ruptured sori in an infected crop and the gradual increase in number of infected ears in the crop over a period of about two and a half months, from the beginning of September to the middle of November, indicate that such secondary infection does occur in nature.

Div. of Mycology & Plant Pathology,
Ind. Agri. Res. Inst.
New Delhi,
January 5, 1950.

R. S. Vasudeva.
M. R. Seshadri Iyengar.

1. Ajrekar, S. L. and Likhite, V. N., *Curr. Sci*, 1933, **1**, 215.

MODE OF TRANSMISSION OF THE LONG SMUT OF JOWAR

The long smut of Jowar caused by *Tolyposporium Ehrenbergii* (Kuehn) Pat., known both in India and elsewhere, is generally confined to occasional ears, each possessing only a few sori, but severe outbreaks, sometimes amounting to about 10% of the total grains in an ear and as much as 44% of the crop have been noted occasionally. In devising control measures against this, as against any other disease, it is essential to know first the mode of transmission of the causal organism. This was unknown till 1945 when Prasad[1] reported the disease to be air-borne. Experiments carried out at this Institute in the same year to determine the mode of transmission were unsuccessful.[2] Experiments repeated in the two succeeding years also gave negative results.[3,4] Last season, however, typical infection was successfully produced in more than 50% of the ears of a local variety of Jowar inoculated with spores of the fungus obtained from Punjab (I). The method of inoculation consisted in forcing into the boot enclosing the young inflorescence a suspension of spores in water using a hypodermic needle. The infection appeared 2 to 3 weeks after inoculation and the number of sori produced in individual infected ears varied from 1 to 12.

The failure of the earlier experiments can be ascribed to the prevalence of unfa-

vourable climatic conditions in Delhi, where the disease does not generally appear.

Recently, Ramakrishnan and Reddy[5] while reporting the success of artificial inoculations, observed that the "mode of infection of this smut is so far unknown," apparently overlooking the earlier record by Prasad (*loc. cit.*) However, their findings, as ours, confirm conclusively that the disease is air-borne and that infection takes place either when the inflorescence is still enclosed in the boot, or about the time it emerges, when the flowers are still very young. The source of infection, however, is still obscure. In this disease, as in many air-borne diseases, it is tacitly assumed that spores lying in the soil germinate just when the ears are in a susceptible stage. It is known from the experiments of Ramakrishnan and Reddy (*loc. cit.*), as well as ours, that the spores of long smut do not have any dormancy period and, from the experiments of Kamat,[6] that they germinate in the presence of sufficient moisture at a temperature varying from 15° to 36° C., the optimum being 28° C. Such conditions of moisture and temperature are presumably available in the soil during different periods of the year. One may suggest, therefore, with equal plausibility, that the infection may come from weed-grasses serving as alternate hosts, though this can only be proved by survey and cross-inoculation experiments. Such experiments are in progress at this Institute.

Thanks are due to Mr. Chetan Swarup Paracer, Assistant Plant Pathologist, Punjab (I), for supplying the material of long smut.

Div. of Mycology, & Plant Pathology, Ind. Agri. Res. Institute, New Delhi, *December* 5, 1949.

R. S. VASUDEVA.
M. R. SESHADRI IYENGAR.

1. Prasad, N., *Curr. Sci.*, 1945, **14**, 239. 2. *Sci. Rep. Indian Agric. Res. Inst.*, 1946, 3. *Ibid.*, 1947. 4. *Ibid.*, 1948. 5. Ramakrishnan, T. S., and Reddy, G. S., *Curr. Sci.*, 1949, **18**, 418. 6. Kamat, M. N., *Phytopathology*, 1933, **23**, 985–92.

ANGIOSPERMIC REMAINS FROM BARMER SANDSTONES

WHILE comparing the figures of fossil pollen grains from "Barmer Sandstones" of Jodhpur, reported by Bose,[1] with those in the catalouge of our own collection of living angiospermous pollen grains, we found that they offer a close approach to the pollen grains of the family Onagraceæ in their general shape and form, as also in the presence of germ spores. Bose's figure 4, is almost identical with our figure of *Fuchsia* (Fig. 1); and his figure 3 to *Epilobium* (Fig. 2) and figure 2 to *Chamanerium* (Fig. 3) already described and sketched by Erdtman.[2]

FIG. 1. *Fuchsia*: showing a triangular pollen grain, with three germ pores. 98 μ.

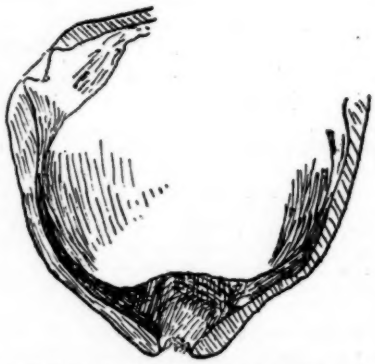


FIG. 2. *Epilobium**: showing the triangular nature of the pollen grains with germ pores. 76 μ.

It is significant that the genera referred to above, all belong to the family Onagraceæ. In fact, the pollen grains of this family so far studied in this laboratory[3], as well as by Erdtman[2] and Pope,[4] all conform to the tricolpate type of Wodehouse,[5] namely, that they are triangular in outline, provided with one germ pore at each of the angles. Bose's fossil

* Figs. 2 and 3 have been coupied out and reproduced from Erdtman (2) for ready reference.

FIG. 3. *Chamaerium** · *Ibid.* 85 μ.

pollen grains would therefore recall and suggest a comparison with living Onagraceous type of pollen grains.

Dept. of Botany, T. C. N. SINGH.
Annamalai University, A. T. NATARAJAN.
Annamalainagar,
February 5, 1950.

1. Bose, M. N., "Angiospermic remains from Barmer Sandstones, *Curr. Sci.*, 1949, **18** (7), 246-247. 2. Erdtman, G., "An Introduction to Pollen Analysis," *Chronica Botanica Company of Waltham, Mass., U.S.A.*, 1943, 112-13. 3. Two species of *Fuchsia* and one species of *Jussieua*. 4. Pope, M. A., "Pollen Morphology as an Index to Plant Relationship," *Botanical Gazette*, 1925, **80**, 63-73. 5. Wodehouse, R. P., "Pollen Grains" *McGraw-Hill Book Company Inc., New York and London*, 1935, 152-210.

LEAF BLIGHT OF *PANDANUS* SPP.

LEAF blight of Pandanus plants was observed by the author in the University and National Botanical Gardens, Lucknow, during the rainy season of 1948. A general survey revealed that 2 spp. of *Pandanus*, *P. odoratissimus* (Keora) and *P. fascicularis* were affected by the disease. Microscopic examination revealed that an *Alternaria* which was later determined as *Alternaria tenuis Auct.* (Neergard) was constantly associated with the disease.

The disease is mainly restricted to the leaves. During the rainy season small oval or elliptical etiolated areas arise on the leaf and later on take a darker shade developing into large oval, elliptical or cylindrical areas with their longitudinal axes parallel to the midrib (Fig. 1). Under high humidity and temperature the spots enlarge, turn black due to preponderance of conidia, coalesce, often covering the entire leaf. In several cases, perforations also appear in the spots, leading to premature defoliation, and consequently to scanty flowering on some male plants of *P. odoratissimus*.

The fungus was cultured on standard synthetic agar medium. Two days after inoculation cottony mycelium appeared and gradually formed a colony having alternate zonations of white and grey colour. When the colony had grown to its full size it became deep black due to preponderance of conidia and was velvety in appearance. The fungus is culturable at various temperatures ranging from 4° C - 32° C. but the optimum temperature is 25° C. It can be cultured on several media, fairly good growth occurring in synthetic, potato dextrose and oat-meal agar medium. In old cultures, crystals like those described by Neergard also appeared.

Conidial observations and measurements were made from 10-12-day old cultures on synthetic medium. The vegetative hyphæ are hyaline, septate, and filamentous. Conidiophores in natural conditions emerge through stomata or ruptured portions in cuticle but in cultures arise as side branches on hyphæ and are olive brown in colour. Conidia occur in chains of 7-9. They are olive brown in colour, beaked and are obclavate and long oval in shape when mature. Both transverse and longitudinal septa are present and they are generally 5-7 celled (Fig. 2). Beaks are short

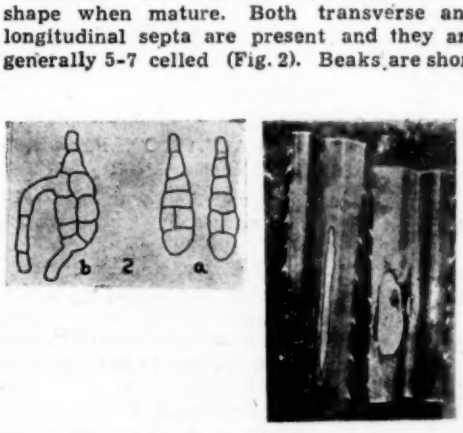


FIG. 1. Photograph showing leaf spots, × ½
2*a*. Camera lucida drawing of conidia, × 400. 2*b*. Camera lucida drawing of germinating conidium, × 400.

and false having the same colour as that of the spore body. Conidia measure 8-78 $\mu \times$ 6-22 μ.

Great confusion prevails with regard to the identification of species of the genus *Alternaria*, first described by Nees in 1817. Elliots' paper gave the first scheme of classification. Later on Neergard's elaborate description of specific characters made it possible to determine the species without much difficulty.

Pathogenicity of the fungus has been repeatedly tested under uniform conditions partly on seedlings in the garden and mainly on the typical spiral of 3 leaves under aseptic conditions in the laboratory. The leaves were treated with 10% $HgCl_2$ washed well with sterilised water, and spores were introduced on the surface by needle pricks After about 2-3 days spots appeared which gradually increased and became dark brown. These on being cultured under sterile conditions gave typical *Alternaria tenuis*. This proved the fungus to be a pathogen although a weak one, for the disease could be produced artificially only on wounded leaves. This accounts for the lower leaves being more diseased as they are comparatively less resistant.

Grateful acknowledgments are due to Prof. H. P. Chowdhury for guidance and to Dr. B. B. Mundkur for valuable information.

Department of Botany,
University of Lucknow, M. KAMAL.
Lucknow,
January 16, 1950.

1. Elliot, J. A., *Am. Jr. of Bot.*, 1917, **4**, 139. 2. Neergard, P., *Danish spp. of Alternaria and Stemphylium.*

MEGASPORES FROM LOWER GONDWANA OF SINGRAULI COALFIELD, DISTRICT MIRZAPUR

A SAMPLE of coal (Lower Gondwana) collected from a thin seam exposed in a small rivulet north of Kotah (24° 6′ – 82° 45′); district Mirzapur (U P.) (kindly given me by Dr. R. C Misra) yielded numerous megaspores besides a great number of microspores, woods and cuticles. A good number of megaspores cut in various planes can be seen in thin sections of coal (Fig. 2).

The megaspores vary greatly in size, from about 303 μ to about 3 mm. (Fig. 1) in diameter (Some increase in size is no doubt due to their flattening). Most of them are very well preserved and exhibit their tri-radiate mark as well as sculpturing.

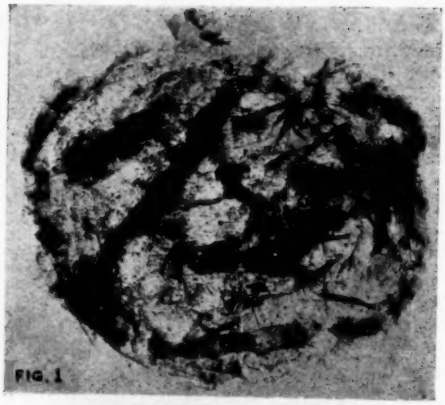


FIG. 1

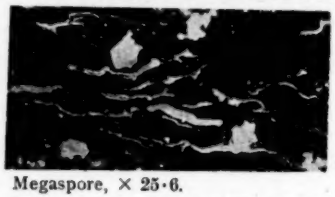


FIG. 2

FIG. 1. Megaspore, × 25·6.

FIG. 2. Thin section of coal showing four megaspores in Section, × 31.

Sitholey[1] described only megaspore casts from the Triassic of the Salt Range and only one megaspore is recorded from the upper Tertiary rocks of Assam.[2] Besides these, the author has not come across any other published record of megaspores, from India. The present discovery of megaspores in great profusion is, therefore, very interesting. It affords evidence of the existence of lycopods in the Palæozoic of India, whose presence is otherwise unknown. A full account of the findings will be published elsewhere.

I wish to thank Dr. R. C. Misra for the loan of the coal sample.

Botany Department, B. S. TRIVEDI.
Lucknow University,
February 25, 1950.

1. Sitholey, R. V., *Proc. Nat. Acad. Sci. India*, 1943, **13** (5), 300-27. 2. Sahni, B., *et al. Jour. Ind. Bot. Soc.*, 1947, **26**, (4), Plate 17, fig. 47.

EFFECT OF PHOTOPERIOD ON THE FLOWERING TIME OF TWO LATE VARIETIES OF PADDY

THE influence of different day length on the flowering time of varieties of paddy from Bengal and Bihar has been studied by Sircar and others.[1–10] Here, the photoperiodic response of

two late varieties of paddy from U.P. (*agahani* or *Jarahan*) when the treatment is given at different stages of growth of the seedlings is reported.

Pure seeds of T. 23 (a selection from *Kala Sukhadas* of Banda District) and T. 36 (a selection from a winter variety of Cuttack), after sterilisation, were sown in flat earthenware pots and transplanted after twenty days to bigger pots containing well mixed soil-manure mixture. New leaves appeared in ten days. The controls were subjected to the full daily period of natural illumination. Of the test the first set was subjected to daylight for 10 hours a day only (8 a.m. to 6 p.m.) when the seedlings were 30 days old; the 2nd, 3rd, 4th, 5th and 6th sets being subjected to this short-day photoperiod when the seedlings were respectively 40, 50, 60, 70 and 80 days old. In each case the short-day treatment was continued till ear emergence was noticed in the individual plants. The method of obtaining the short-day light period is the same as in previous work.[4] The age of the seedlings was counted from the sowing date. The results are presented in Table I.

TABLE I

Sowing date, June 26, 1949. Transpanting date, July 16, 1949. + indicates induced earliness; — indicates induced delaying effect.

Serial No. of the sets	Date on which the treatment was commenced	Age of the seedlings in days at the time of the commencement of the treatment	Period from sowing to first panicle emergence in days (average of 24 plants)		Difference from control in days	
			Var. T. 36	Var. T. 23	Var. T. 36	Var. T. 23
1	July 26	30	67·6	82·8	+46·1	+29·9
2	Aug. 5	40	77·0	83·2	+36·7	+29·5
3	Aug. 15	50	86·9	92·7	+26·8	+20·0
4	Aug. 25	60	95·9	102·3	+17·8	+12·4
5	Sept. 4	70	107·0	112·2	+ 6·7	+ 0·5
6	Sept. 14	80	109·4	113·4	+ 4·3	− 0·7
7	Control		113·7	112·7		

A study of the results in Table I shows that short-day treatment from early stages of growth of the plants greatly hastens the date of the first panicle emergence in the two varieties of rice under observation. But there is a good deal of varietal difference between the two. In case of variety T. 36 the maximum earliness observed is 46·1 days when the treatment is started with 30 days old seedlings whereas the corresponding figure for the variety T. 23 is only 29·9 days, although the normal flowering period in both the varieties is almost the same. As the date of the commencement of the short-day treatment is delayed by a period of 10 days for the successively later sets of 40, 50, 60 and 70 days old seedlings there was a progressive delay in the onset of the flowering time in variety T. 36 and the various sets flowered at about ten days intervals throughout their growth period in contrast to the behaviour in variety T. 23 where the 30 days and the 40 days sets came to flower together. Further, in the variety T. 36, an earliness of 4·3 days was observed even when the short-day treatment was commenced at an advanced age of 80 days but in the variety T. 23 there was no marked earliness when the treatment was started with 70 and 80 days old seedlings. In view of these differences in their responses towards the short-day photoperiod variety T. 36 may be considered a "sensitive" one and variety T. 23 a "less sensitive" one.

Grateful thanks are due to Prof. Shri Ranjan for his helpful criticism and guidance during the course of this investigation.

Dept. of Botany, GADADHAR MISRA.
University of Allahabad,
February 22, 1950.

1. Alam, M., *Det. Sci. Rep. Rice, Res. Stat. Sabour, Bihar (India)*, 1940–41. 2. Kar, B. K., *Nature*, 1946, **157**, 811. 3. — and Adhikari, A. K., *Sci. and Cult.*, 1944–45, **10**, 506–08. 4. Misra, G., *Curr. Sci.*, 1949, **18**, 413–14. 5. Saran, A. B., *Jour. Ind. Bot. Soc.*, 1945, **24**, 153–61. 6. Sen, N. K., *Ibid.*, 1948, **27**, 111–18. 7. Sircar, S. M., *ibid.*, 1942, **21**, 41–50. 8. —, *Proc. Nat. Inst. Sci. India*, 1946, **12**, 191–98. 9. —, and Ghosh B. N., *Nature*, 1947, **159**, 605. 10. —, and Parija, B., *Proc. Nat. Inst. Sci. India*, 1949, **15**, 93–107.

INDIAN ROSIN OIL FROM *PINUS EXCELSA*

THE problem of the effective commercial utilisation of various types of indigenous resins, and in particular the disposal of inferior grades of Indian rosin, considerable quantities of which are available, has as yet found no satisfactory solution. In western countries, rosin oils are used in the preparation of lubricants, varnishes, inks, antiseptics, etc. In order to study the chemical nature and to isolate the chemical ingredients as far as possible of a similar product from indigenous rosins, a rosin oil has been prepared from the rosin (12·5 kg.) from *Pinus excelsa* by the method of destructive distillation in iron retorts in an yield of 75%.

Besides the oil, considerable amount of gas and a very porous residue consisting mainly of carbon are also obtained. The oil was separated from aqueous distillate and after removal of acidic constituents by shaking with 5 per cent. sodium carbonate solution, was fractionated repeatedly. The sodium carbonate extracts from every fraction were evaporated to dryness and the acids were isolated by treating the residue with concentrated sulphuric acid. Individual acids were separated by repeated fractionation and identified as their anilides and p-toluidides. The solid acids which consists mostly of abietic acid was isolated from fractions E, F and G, crystallised from glacial acetic acid and identified.

The individual fractions of the neutral oil were examined separately by repeated fractionation using an efficient Vigreux partial condensation take-off type column, and the individual fractions analysed. Fractions boiling above 250° gave uniformly high yields (40-50%) of retene on dehydrogenation with selenium.

The results are summarised in Tables I and II.

A proximate composition of the distillate is given below. (Figures within the brackets indicate the percentage on the weight of the distillate.)

Total volatile acids expressed as acetic acid .. .. .. (1·5)

Total non-volatile acids expressed as abietic acid .. .. .. (3·5)

TABLE I

	Weight in gram.	Percentage yield on the weight of the rosin	Products isolated
Gases		16·26	CO, 64·1%; CO_2, 9·3%; O_2, 3·7%; H_2, 8·9%; C_nH_{2n}, 2·9%; C_nH_{2n+2}, 13·0%
Aqueous Distillate	710·5	5·9	Acetic acid, Propionic acid.
Acidic Constituents	292·8	2·39	Isobutyric acid, isovaleric acid, and abietic acid
Oily Distillate ..	7913	64·6	See Table II
Residue ..	1050	8·57	Mainly carbon with traces of iron oxide and silica

TABLE II

No.	B.P. Range	% on the wt. of the Rosin	Sp. Gr. $D^{15\cdot5}_{15\cdot5}$	Refractive index n^{28}_D	Specific Rotation $[\alpha]^{24}_D$	Absolute Viscosity	Acid Number	Saponification Value	Iodine Value	Individual Compounds Characterised
A	Up to 150° C.	1·26	0·8644	1·4653	3·521	0·9208	30·63	30·21	87	Isobutyric aldehyde, methyl alcohol, 2-hexene, methyl cyclohexane, Toluene, p-xylene, acetic acid & propionic acid
B	150°–250° C.	2·16	0·9053	1·4929	19·618	2·586	14·34	14·8	78	p-Xylene, isobutyric acid, isovaleric acid, cumene, α & β pinenes, & p-cymene
C	250°–290° C.	2·5	0·9070	1·5262	47·364	25·13	7·77	7·69	71	Abietic acid, various hydrogenated derivatives of retene, *e.g.*, dihydro retene tetrahydro retene, octahydro retene, perhydro retene, abietene and retene
D	290°–330° C.	31·84	0·9774	1·5378	49·092	83·12	6·62	6·6	69	
E	180°–210° C./10 mm.	17·96	0·9308	1·5354	36·71	123 6	3·098	5·23	69	
F	210°–235° C./10 mm.	7·44	1·011	1·5750	30·8	459·8	25·82	28·6	58·5	
G	Above 235°C./10 mm	1·44	..	..	15·728	..	36·17	36·53	..	Mainly retene and abietic acid

Aliphatic unsaturated hydrocarbones	(0·4)
Isobutyric aldehyde	(0·2)
Methyl alcohol	(0·15)
Methyl-cyclohexane	(0·4)
Total aromatic hydrocarbons ..	(1·5)
Total pinenes	(0·4)
Abietene and Hydro derivatives of retene	(70–80)
Retene	(1·4)

Isovaleric acid, 2-hexene and p-xylene are present in the rosin oil from *Pinus excelsa* and these compounds have not been reported in any of the rosin oils from the pine [1, 2, 3].

Organic Chemistry Laboratories,
Indian Institute of Science, I. S. PATEL.
Bangalore 3, P. C. GUHA.
April 3, 1950.

1. Renard, *Ann. de. Chemie et Physique*, 6e *serie*, 1884, p. 223. 2. Kelbe, Berichte, 1880, **13**, pp. 1157 and 1827; 1881, **14**, p. 1240. 3. Kelbe, *Ann. de Liebig*, 1881, **210**, p. 1.

THE EFFECT OF INTAKE OF ZINC ON METABOLISM

PART A

IT was pointed out earlier[1] that the intake of zinc exerted an influence on the fat content of liver in the rat when it was supplemented to a high fat, low protein diet and that irrespective of the nature of the diet, zinc supplements adversely affected the development of the bones. Prabhu[2] records that zinc is used to cure infantile cirrhosis of liver in the indigenous systems of medicine. It was therefore of interest to find out if zinc influenced the metabolism of nitrogen, phosphorus and sulphur in rats fed on a stock diet and high fat, low protein diet.

Table I presents the results of experiments conducted on three groups of four rats each with a view to studying the effect of zinc (supplied as zinc oxide at 0·5 and 1·0 per cent. levels) on the metabolism of N, P and S in rats on a stock diet.

The results show that supplements of zinc affect metabolism of all the constituents studied. While urinary excretion of nitrogen is affected only at the higher level of zinc, fæcal excretion and retention are altered to a very appreciable extent at all the levels of zinc tried. Its influence on the metabolism of phosphorus and sulphur appears to be more marked. Thus there is a considerable decrease in urinary excretion and retention and a corresponding increase in fæcal excretion of these

TABLE I

Metabolism of nitrogen, phosphorus and sulphur in rats fed on a stock diet supplemented with zinc

Diet	Urinary* mg.	Fæcal* mg.	Retention* mg.
Nitrogen :			
Stock diet alone	338·71	892·76	2646·63
Do. *plus* 0·5% ZnO	355·08	1091·17	2186·35
Do. *plus* 1·0% ZnO	516·20	1121·65	1730·75
Phosphorus :			
Stock diet alone	41·37	143·79	326·44
Do. *plus* 0·5% ZnO	4·29	477·79	239·52
Do. *plus* 1·0% ZnO	4·59	573·23	54·78
Sulphur :			
Stock diet alone	23·94	86·90	−53·15
Do. *plus* 0·5% ZnO	15·76	129·25	−86·51
Do. *plus* 1·0% ZnO	16·84	155·50	−121·04

* Total for a period of fifteen days and average for the group consisting of four rats.

constituents as a result of the supplements of zinc. These observations lead to the conclusion that zinc in some manner affects the assimilation of these constituents in the intestines, so that the reserves of the body are mobilized in order to maintain their concentration in the body fluids. This appears to be the reason for the retarded growth rate and poor development of the bones of rats fed on a diet supplemented with zinc and possibly also for other toxic symptoms reported by Sutton and Nelson[3] and Smith and Larson.[4]

In experiments conducted with high fat, low protein diets also, observations substantially similar to the above were made.

Table II shows that zinc causes an increase in the urinary excretion of both uric acid and total creatinine when the basal diet consists of the stock ration. This may be because of the general wastage especially of the muscle tissues. On a high fat, low protein diet, uric acid excretion shows a slight tendency to decrease. As far as the excretion of creatinine is concerned, the composition of the diet appears to make some difference in that while zinc tended to increase the urinary excretion of creatinine in rats on a stock diet, it lowered its excretion in those fed a high fat, low protein diet. The reason for this difference is not clear.

The manner in which zinc lowers the fat content in the liver of rats fed on a high fat, low protein diet is also not quite clear, but it

TABLE II

Excretion of uric acid and total creatinine in the urine of rats fed on a stock diet and a high fat, low protein diet supplemented with zinc

Diet	Three-day periods 1	2	3	4	5	Total
	Milligrams					
Uric Acid:						
Stock diet alone	0·242	0·762	0·778	0·929	1·182	3·893
Do. *plus* 0·5% ZnO	0·378	0·843	0·971	1·036	1·056	4·284
Do. *plus* 1·0% ZnO	0·504	1·033	1·139	1·381	1·390	5·447
High fat, low protein diet	0·202	0·170	0·532	0·278	0·429	1·611
Do. *plus* 0·5% ZnO	0·311	0·418	0·446	0·141	0·259	1·575
Do. *plus* 1·0% ZnO	0·227	0·211	0·238	0·139	0·191	1·006
Total Creatinine:						
Stock diet alone	1·700	1·373	2·064	2·173	5·303	12·613
Do. *plus* 0·5% ZnO	2·178	2·218	3·041	2·984	3·976	14·397
Do. *plus* 1·0% ZnO	2·116	2·909	4·291	4·822	6·473	20·611
High fat, low protein diet	0·958	1·078	1·075	2·773	5·964	11·848
Do. *plus* 0·5% ZnO	0·958	1·312	2·382	1·822	2·259	8·733
Do. *plus* 1·0% ZnO	1·208	1·466	1·594	1·227	1·373	6·868

is likely that zinc, by inhibiting the phosphorylation of fat to form phospholipids, prevents its migration from the intestines to the liver. In this event, it is to be expected that in rats fed a diet supplemented with zinc, there should be an appreciably greater excretion of fat in the fæces than in the control. But this appears not to be the case. Further investigation is in progress.

PART B

In an experiment designed to find out the metabolism of fat in rats fed on a high fat, low protein diet with and without the supplement of zinc, it was observed that fæcal fat did not show any appreciable increase in the zinc-fed group during the period of fifteen days (Table III).

These results show that fat is assimilated without impairment even when the assimilation of phosphorus from the intestines is poor and thus support the contention of Frazer[5] who has adduced some evidence to show that phosphorylation of fat is not a necessary intermediate step in its assimilation from the intestines. The explantion for the lipotropic action of zinc has, therefore, to be sought for elsewhere.

It is a pleasure to thank Major-General Sir S. S. Sokhey and Dr. K. Ganapathi for their interest in this work.

Haffkine Institute, Bombay, *January* 18, 1950. V. SADASIVAN.

1. Sadasivan, V., *Curr. Sci.*, 1950, **19**, 10. 2. Prabhu, M. B., *Indian J. Pediatrics*, 1940, **7**, 121. 3. Sutton, W. R., and Nelson, V. E., *Proc. Soc. Exp. Biol. and Med.*, 1937, **36**, 211. 4. Smith, S. E., and Larson, E. J., *J. Biol. Chem.*, 1946, **163**, 29. 5. Frazer, A. C., *Physiol. Revs.*, 1946, **26**, 310.

TABLE III

Metabolism of fat in rats fed on a high fat, low protein diet supplemented with zinc

Diet	Three-day periods 1	2	3	4	5	Total
	Grams					
Fat in Diet:						
High fat, low protein diet	6·248	6·075	5·880	5·745	5·380	29·328
Do. *plus* 0·5% ZnO	4·820	3·940	4·205	4·205	4·145	21·315
Fæcal Fat:*						
High fat, low protein diet	0·1483 (2·375)	0·1982 (3·263)	0·1197 (2·036)	0·1125 (2·010)	0·2656 (4·937)	0·8443 (2·879)
Do. *plus* 0·5% ZnO	0·1523 (3·159)	0·1207 (3·063)	0·0775 (1·367)	0·2201 (5·234)	0·1376 (3·319)	0·7082 (3·323)
Fat Assimilated:						
High fat, low protein diet	6·0997	5·8768	5·7603	5·6295	5·1144	28·4807
Do. *plus* 0·5% ZnO	4·6677	3·8193	4·1275	3·9849	4·0074	20·6068

* Figures in brackets indicate fæcal fat as percentage of dietary fat.

ANTIBIOTIC PROPERTIES OF LIVER-PROTEIN HYDROLYSATE

GOAT being the more common animal used for meat in India, most liver extracts in this country are naturally made from this biological source.

The usual method of making liver extracts is by digesting the liver with papain. The concentrated aqueous filtrate is treated with strong alcohol upto 70% to give precipitate (No. I). The alcoholic solution is again concentrated in vacuum and further treated with strong alcohol bringing the mixture as before to 70% to obtain precipitate (II). Dried at 70° C. under vacuum, the peptone, originally white, oxidises to a brown mass, due probably to tyrosine. Precipitate (II), on drying to a constant weight, gave 14% nitrogen; solubility in water about 10%; pH of saturated solution was 4·5; nitrogen content 1·4%, representing 8·75% protein; amino-nitrogen, by formal titration, 0·6%. Qualitative tests for tyrosine, tryptophane, methionine and cystine were all positive. Active charcoal, "Norit K" adsorbed the dark colour, but the pale straw-coloured filtrate still indicated the presence of all the four amino acids mentioned above.

Precipitate (II) does not function as peptone for bacteriological purposes. A 3·6% solution of this liver-peptone, indicated anti-biotic properties. The 10% solution of liver-peptone of pH 4·5 was diluted and ammonia was added to give the concentrated solution a pH of 7·0, which was further diluted as indicated in Table I.

The solution, which had about 4% liver peptone after adsorption, was just resistant to natural infection by putrefying bacteria, whereas solutions containing 3% and less were not.

The colour adsorbed by charcoal, as measured with Lumetron, indicated 64% adsorption leaving 36% behind comparable with a solution containing 3·6% liver-peptone of Table I. The findings with colour adsorption, given in Table II, thus confirm the data presented as different strengths of peptone solution given in Table I.

TABLE I

Effect of diluting liver peptone solution on bacterial growth

Concentration of dry liver peptone	Visual turbidity	Smell after 4 days
10%	Nil	Normal
5%	,,	,,
4%	,,	,,
3%	Turbidity, bacteria present	Putrefaction after 24 hrs.
2%	,,	Worse
1%	,,	Worst

TABLE II

Effect of adsorbing the antibiotic factor of "Norit K"

"Norit K" added	Colour adsorbed in percentage	Putrifaction after 4 days
100 mg. ..	10	Nil
200 mg. ..	32	Nil
500 mg. ..	64	Nil
1 G. ..	83	Putrefaction after 24 hrs.
2 G. ..	97·6	,,
3 G. ..	98·5	,,
4 G. ..	99·8	,,
5 G. ..	100	,,

The antibiotic properties of protein hydrolysate appears to have been rarely recorded.[1] Tables I and II offer *in vitro* experiments explaining in part the mechanism of natural immunity.

Cipla Laboratories, Bombay 8, *December* 12, 1949.

S. MAHDIHASSAN.
V. M. BAKSHI.

1. Nutini and Lynch, *J. Pharm. Exp. Ther.*, 1947, **90**, 313—through *Manuf. Chemist*, **18**, 565.

ERRATA

The following paragraph must be included on page 84, March 1950 issue of *Current Science*, at the end of the paper entitled "*Palana, Lignite* (? *eocene*), Bikaner," by A. R. Rao and K. P. Vimal, just before the last paragraph:—

"S. R. N. Rao and Misra (*Current Science*, Oct. 1949, p. 380) have already reported the occurrence of a *Botryococcus Brawni* (-like alga) in these lignites. The present note records for the first time the occurrence of various kinds of fossil pollen in the same meterial. A fuller account of the microfossils in these lignites, which are being studied further, will be published elsewhere."

REVIEWS

Chemical Engineering Plant Design. By F. C. Vilbrandt. (McGraw Hill), 1949. Pp. vii + 608. Price $ 6·00.

Most of the successful laboratory processes for chemical production cannot be majored into commercially feasible propositions unless they are piloted carefully through medium scale engineering stages. The chemical and engineering informations obtained thereby, are then to be co-ordinated into a design for an assembled full-scale chemical manufacturing plant. The design of a preliminary pilot plant from the available laboratory experimentation data, as also that of a full-scale production plant involve a careful consideration of quantitative flows of materials in process, specification and organisation of the major and the auxiliary equipment, and a study of storage and expansion. Such a design has finally to be analysed by a preconstruction cost accounting for an appraisal of its success as a commercial venture.

An outstanding text and reference book dealing precisely with this aspect of design of assembled plant was first published by F. C. Vilbrandt in 1934 and has remained as a *vade mecum* particularly for all the initiates into the Practice of Chemical Engineering. Since the first publication of the book, no revolutionary changes have been introduced into the principles of plant design, but a considerable amount of very useful data on equipment and materials have accumulated in published literature. Prof. Vilbrandt has therefore taken a timely and much welcome step in bringing out a thoroughly revised third edition of his book. How thorough the revision has been, can be immediately gauged from the fact that the bulk of the book has increased from 341 pages in 1934 to 587 pages in the present edition.

This opportunity has been taken also to rearrange the thirteen chapters of subject-matter into better logical sequence. The chapter that has received the greatest attention by way of a very material revision and expansion, is the one dealing with "Preconstruction cost accounting" which now includes cost indexes and all of the most recent cost data. Such a considerable expansion of this chapter from 41 pages to 135 pages, has created markedly the need—which it is hoped will be fulfilled in the next edition—for a page schedule of the chapter subdivisions, particularly as this will be a much used reference chapter. A corresponding schedule for the other chapters as well, would also be welcome, although this has been indicated but not exactly, on page 3, in the body of the book.

Attention must also be drawn to another material change in the book due to the substitution of the illustrative design problem on ferrous sulphate recovery by a new complete project on a "gamma-benzene hexachloride production unit" which has been worked out in good detail.

The get-up of the book is up to the usual excellent standards of the publishers. A few misprints have been noticed such as 14519 for 14319 under "B-1, chlorinator" on page 259, and the rather obvious errors in the first six lines on page 269.

Vilbrandt's book takes a high rank among chemical engineering texts, and will continue to be popular and highly useful.

M. A. G. RAU.

Thermodynamics of Dilute Aqueous Solutions. By M. J. N. Pourbaix.* Translated by J. N. Agar, with a Foreword by U. R. Evans, with numerous diagrams. (Edward Arnold & Co., London), 1949. Pp. xv + 136. Price 30*sh.* net.

The book under review gives a generalised thermodynamic treatment of chemical and electrochemical changes in aqueous solutions. For this purpose the author writes all reactions in the general form :

$$aA + bB + cH_2O + mH^+ + ne^- = O$$

in which the substance (or group of substances) A, changes into the substance (or group of substances) B, the only other species involved being H_2O, H^+ and electrons e^-. The method of treatment may be novel to many, but leads to the interesting result that equilibrium can be generally expressed as a function of the *same* two independent variables, *viz.*, pH which determines the influence of H^+ ions and the potential E which determines the influence of electrons. The reactions are then divided into two main classes : (i) those without oxidation, and (ii) those with oxidation. Reactions of class (i) are subdivided into : (A) those in which neither H^+ ions nor electrons are involved, and (B) those in which H^+ ions play a part. Similarly reactions of class (ii)

are subdivided into: (C) those involving electrons, and (D) those involving electrons and H^+ ions. Such a classification at once leads to the following results:—

Reactions of class (i) A will be independent of pH and potential;

Reactions of class (i) B will depend on pH but not on potential;

Reactions of class (ii) C will depend on potential but not on pH; while

Reactions of class (ii) D will depend on both pH and potential.

The author then derives general equations representing equilibria in which the equilibrium constant and potential are obtained in terms of standard chemical potentials of the various species involved:—

$$\log K = \frac{\Sigma_\gamma \nu_\gamma \mu_\gamma^0}{1363},$$

$$E_0 = \frac{\Sigma_\gamma \nu_\gamma \mu_\gamma^0}{23{,}060\, n}.$$

He has thus been able to treat a variety of reactions in the same general manner. He has also devised a graphical method of representing the influence of these factors on equilibria, homogeneous and heterogeneous.

In the words of Dr. Evans, the method of treatment "offers a common elucidation of numerous problems which are today regarded as quite distinct, and concentrates a vast mass of pertinent data in diagrams which, *to those who have gained familiarity with his system, are remarkably simple*". (Italics the reviewer's.) To gain familiarity with his system is not so simple. The monograph is by no means easy reading.

More explanations are needed in the construction of the graphs and their interpretation. The calculations require a knowledge of standard chemical potentials of the various species concerned, the values of which for all substances are not yet available, a fact recognised by the author also. This limits the usefulness of the book, but provokes future research.

The monograph cannot be used with advantage by a beginner, but the advanced student will find it a thought-provoking and stimulating contribution to thermodynamics.

S. N. SHUKLA.

* The author, Dr. Pourbaix is, of Belgian nationality, has had a distinguished educational career and has collaborated with Professors Dony and Erculisse of Brussels and Scheffer and Burgers of Delft besides others. He is now organizing the Research Group at the Universite Libre de Bruxelles.

Co-operative Rural Development in India: a Plan. By G. P. Shukla (Published by The Universal Publishers Ltd., Lucknow), 1949. Pp. 152. Price Rs. 3/12.

The Royal Commission on Agriculture in India observed as early as in 1927 that if co-operation failed, there would fail "the best hope of rural India" and nearly 20 years later the Co-operative Planning Committee (one of the many that the Government of India appointed in those delirious days of Planning, 1943-45) said, "The Co-operative Society is the most suitable medium for the democratisation of economic planning, as it provides the local unit which can fulfil the dual function of educating public opinion in favour of a plan and of executing it." On the basis of these principles, the author has analysed the problems of rural reconstruction through the establishment and proper working of the Panchayats. He proposes a Panchayat which he would term the Gaon Sabha in every village as a multipurpose co-operative society—with an elected Committee of Management to be called the Gaon Panchayat. He critically surveys the United Provinces Panchayat Raj Act of 1947, and suggests that in every village this panchayat and the co-operative society must be combined into a single organization—not only for assisting the development of agriculture, commerce and industry as contemplated in the aforesaid Panchayat Raj Act, but also for providing for medical aid, cattle farming, education, sanitation, roads, marketing, liquidation of indebtedness and development of co-operation and establishment of improved seed and implement stores, and the welfare of the village 'abadi' and its residents in every aspect of life. It must be noted that the author is aware that "the Co-operative movement has not been a success in India", during these last 46 years, in fact he discusses briefly the causes of its failure. It will, therefore, require all the faith of a Co-operator in the reader when he has to persue the details of the organization, functions, powers of the Panchayats and their application not only to Agriculture and Allied Industries, but to educational reconstruction, administration and finance with plans ranging from the building of the Panchayat to the consolidation of families—in order that "Every thing in the village must be made to undergo change for the better, so that the villager may forget his past miserable condition, his dead soul may be revived and new energy and spirit may invigorate him." May this optimism be shared by the reader!

M. C. M.

Vegetable Gums and Resins. By F. N. Howes, D. Sc. [Published by The Chronica Botanica Company, Waltham, Mass., U.S.A.), 1949. Obtainable from Messrs. Macmillian & Co., Calcutta, Bombay and Madras. Pp. 188 with 39+2 figures, being reproductions of pen and ink drawings. Price $ 5.

Gums and resins are mainly used in industries as raw material for varnishes, and as such the book would be mostly read by industrial chemists but by the nature of the materials handled only a botanist can write upon them. The author is the Principal Scientific Officer of the Royal Botanic Gardens, Kew, London, and as such most qualified for enlightening the reader upon gums and resins. The printing is excellent and the price very reasonable. We have no doubt that it would prove very useful and that a second edition would soon be called for. The following suggestions are made in the hope that the future edition would prove still more useful than the present one.

What an industrial chemist would like to see is not the plants that produce gums and resins but what the products themselves look like. Of the 39 figures in the text only one, Fig. 6, in part, shows for example gum tragacanth adhering to a piece of a branch; the rest are all pictures of branches, leaves and even flowers such as interest a pure botanist but would appear as mere decorations to the real user of the book, the industrial chemist. On the contrary the two extra pictures entitled "Collecting mastic" and "Collecting Frankincense" go to increase human interest in the subject by their appeal to our historical and artistic sense.

The user of the book would like not only to see "what looks what" but also "what grows where". There are only two maps to satisfy the reader's curiosity in this respect. Both these figures, we fear, are too small to serve their purpose well. Gums aud resins differ very greatly from locality to locality and the main regions should have been better indicated. For example, Fig. 1 represents India in such a small size that the space is not sufficient to bear the four figures it is made to carry. No. 2, for example, in this map indicates "Other Acacia Gums" and the region is that of Gujrat, as if no other part of India comes into question. Fig. 20 shows India of the same size bearing two figures where the spot allotted to No. 1 again corresponds with Gujrat but is supposed to show the region where Rosin or Colophony is produced.

Lac is an insect product, but is included in the book and with justification. As a botanist the author is not expected to be in touch with entomological literature and as such one is surprised to find that one and the same insect is supposed to grow from the plains of Kashmir and Tibet down to Travancore and from the province of Sind in the west to Indochina, in the extreme east.

S. MAHDIHASSAN.

Some Vertebrate Animals of Ceylon, Vol. I. By P. E. P. Deraniyagala. (The Director, National Museum, Colombo), 1949. Pp. ii+119. Price Rs. 3·50 or 7*s*.

To keep the public informed about the faunistic collections made by museums, publications of the type under review are essential, and rightly does the Minister of Education, Ceylon, observe in his Foreword, that "It is one of the most important functions of Museum workers to gather new knowledge together in volumes of this type".

'Some Vertebrate Animals of Ceylon' forms the first of the series and coming as it does under the authorship of Mr. Deraniyagala, the æsthetic aspect and as well the scientific accuracy in delineation are perfect.

Ceylon broke off from peninsular India nearly twenty million years ago and though the fauna resembles that of the mainland, the hand of isolation has also played its part on the island. The three peneplains are characterised by their respective fauna with a certain amount of overlapping. Fishes, reptiles, birds and mammals are figured and their scientific names with vernacular equivalents are given.

The figures could have certainly been reproduced better, particularly the photographs. We are asked to note the eggs in the pouch of *Urocampus* (Pl. 20) but it is impossible to make out anything. In some figures an arrow is drawn; what it indicates, it is not described anywhere: presumably the anus. On p.60, we read that the poison fangs of the cobras, etc., are grooved at their back. This is not so; the groove is always on the anterior face of the tooth. It is also not clear what part of Python the three figures at the bottom of p. 66 are intended to represent.

We presume that this atlas will form a valuable guide to those who visit museums but it is priced high to be within the reach of the common man.

L. S. R.

Scoliodon: Indian Zoological Memoirs, No. II. By E. M. Thillayampalam. *Third Edition*, pp. x + 125, 87 coloured plates and text figures (Lucknow Publishing House, Lucknow). Price Rs. 3-12-0.

The third revised edition of this Memoir on a shark of the Indian Seas (first published in 1928) just issued is a sufficient indication of its value and usefulness for teachers and students of Indian Zoology. It is one of the excellent series of Memoirs on Indian Animal types, planned and edited by Prof. K. N. Bahl of Lucknow.

In the new edition, the text has been suitably revised by the editor himself so as to provide a more functional tone to the anatomical details. Among other improvements may be noted the sections on the new classification of Elasmobranchs and modern views on the freshwater origin of fishes, on cartilage as an embryonic adaptation rather than as primitive skeletal material, on the urea content of elasmobranch blood and its osmotic function, on the functions of the central and atonomic nervous system and on the thermo-receptive function of Lorenzini's ampullae. Further, every chapter has been critically revised on the lines of most recent work. The Memoir is very well printed and is exceptionally good value for the price.

B. P.

The Measurement of Air Flow. By E. Ower. (Chapman & Hall, Ltd.), 1949, Pp. vi+293. Price 30*sh.*

This is the third edition of a very useful book which first appeared in 1927. Recent advances in fluid dynamics and the techniques developed in experimental æro-dynamics naturally call for frequent revisions and the author has attempted in this addition to bring the subject-matter up-to-date.

2. The book is written essentially from the physicist's point of view and all fundamental formulæ and theorems are fully explained; but it would perhaps have enhanced the value of the book if for the benefit of the engineer greater emphasis had been placed on certain practical details and applications, pointing out the experimental difficulties met with, in the measurement of wind speed, turbulence, etc., in wind tunnels.

3. The general presentation of the matter is very satisfactory and the author gives an excellent introduction to the methods and techniques of fluid flow measurement with sufficient theory to make the book self-contained. It may, however, be pointed out that certain parts are not quite up-to-date. For instance, in the section on "Diffusers and Sudden Expansions" the author has confined himself to low speed flow only. In recent years the design of diffusers for high speed wind tunnels has presented many problems. Conventional ideas have not worked successfully and the diffuser types suitable at low speeds are not quite satisfactory at high speeds. Certain unconventional devices have been adopted which have resulted in greater efficiency. Although most of the work done in this field is secret, a reference to recent investigations and a discussion of the problems met with would have been very appropriate.

4. Again Chapter X on the methods of flow measurement based upon the rates of cooling of hot bodies is, it is feared, not sufficiently comprehensive although the fundamentals have been properly stressed. There is no reference to the excellent work of Dr. H. L. Dryden and his associates relating to the application of the hot wire anemometer to the measurement of turbulent and boundary layer flow and the techniques perfected for this purpose.

5. In a general way it is unfortunate that reference to American work should be meagre, since during the last decade the centre of gravity of aeronautical research has to a large extent been shifting towards America.

6. On the whole the author is to be congratulated for his very straight forward and clear presentation of the subject. It should be extremely useful to those engaged in investigations involving accurate measurement of air flow.

7. The general get-up of the book comes up to the usual high standard of Messrs. Chapman & Hall despite economies. The subject index and the author index have, however, been combined together, and might have been given separately with advantage.

P. N.

SCIENCE NOTES AND NEWS

Egyptian Scholarships for Indian Students

In pursuance of their desire to offer reciprocal facilities to Indian students for studies in Egypt and with a view to promoting cultural relations between the two countries, the Government of Egypt have offered three scholarships to Indian students for post-graduate studies in Archæology, Philology and Agriculture with effect from the academic year 1950 at the University of Fouad the 1st. Teaching in Archæology and Philology is done in English while the medium of instruction for Agriculture is Arabic. It is, however, necessary that all intending candidates should possess a fair knowledge of Arabic.

The scholarships will be tenable for the period necessary for the student to acquire a degree in the course for which he is selected, and depending upon the satisfactory progress of the student. The value of the scholarship is fixed at LE 15 p.m. which corresponds to Rs. 205 p.m. apart from the tuition fees which will also be provided by the Egyptian Government. The cost of transportation and other personal expenses will have to be borne by the selected candidates.

Candidates must be *bona fide* residents of India and must possess a Bachelor's degree from a recognised Indian University.

Intending candidates must submit their applications in triplicate in the prescribed forms through the Universities concerned so as to reach the Ministry of Education (Section A-1), Government of India, New Delhi, before April 30, 1950. The prescribed application forms can be had from all Universities in India who have been requested to recommend names.

Industrial X-Ray Plant at Alipore Test House

A 250,000 volt industrial X-ray plant capable of examining steels up to 3" in thickness and lighter metals and alloys up to any thickness normally used in industry has been installed at the Government Test House, Alipore, Calcutta.

The plant at Alipore Test House is available for utilisation by Government departments, public bodies, and manufacturers concerned. Further information about tests, testing fees, etc., may be obtained on application from the Director, Government Test House, Alipore, Calcutta 27. Applicants should give full details of the materials intended to be tested.

Federation of Chemical Industries of Belgium Directory for 1950

The 1950 Directory of the Federation of the Belgian Chemical Industries which has just been issued, contains much useful information on the following subjects: organisation of the Federation, complete list of the names of the members and their addresses, detailed list of chemicals manufactured and sold by them, trade marks of the products and an alphabetical list of the same in Dutch, English, Spanish and German. The volume runs to 450 pages and is sold at 150 B. Franks + 20 B. Franks for postage, payable by check through any intermediary of a Brussels banking-house.

The All India Plastics Manufacturers' Association

The Third Conference of the All India Plastics Manufacturers' Association is being inaugurated by His Excellency Dr. Kailash Nath Katju, Governor of West Bengal, on the 14th April 1950, at Calcutta, under the presidentship of Sree P. D. Himmatsingka. During the last year the Association have organised numerous committees for the consideration of details concerning important matters such as standardisation of wages, sales organisation, protection for industry, licence supervising, standardisation of the indigenous raw materials and Central powder manufacturing.

As regards the manufacture of raw materials, the scheme of the Association is taking shape, and it is encouraging that the Government of India is also behind this move, and would be glad to see a Central unit for the manufacture of raw materials. At the present Conference, the Association proposes to discuss various important matters relating to the Tariff Board report and planning the industry on a more scientific basis.

Coupons for Scientific Materials and Films

Arrangements for purchases on limited scale of scientific materials and films with the help of UNESCO Coupons, have been finalieds. As in the case of Book Coupons, purchasers residing in the country of a member-state of UNESCO which has formally agreed to participate, will pay in national currency and get the Coupons valued in dollars. The selling agencies or the manufacturers of either mate-

rials or films in the participating country will accept the Coupons as payment for the goods to be supplied. These Coupons are designed to avoid difficulties of exchange and import but customs regulations about duties will apply. Two types of Coupons are available, one for use in all countries and the other reserved strictly for purchases in the soft currency countries. For India, the Government have agreed to participate in the scheme and they have received the Coupons for distribution. Applications may be made to Mr. P. N. Kirpal, Dy. Secretary, Ministry of Education, Government of India, New Delhi. The UNESCO office may have some Coupons for supplementing the allotments by the Ministry of Education.

Rare Chemicals

The National Registry of Rare Chemicals, Armour Research Foundation, Illinois Institute of Technology, Technology Centre, Chicago 16, III. (U.S.A.), invites enquiries from scientists in all parts of the world who may want rare chemicals or who can supply them. It is hoped that in future after collecting this information, it may be possible to locate easily and without great delay sources from where rare chemicals could be obtained. Information may kindly be sent to the Science Co-operation Office for South Asia, Delhi, for forward transmission. The Unesco Office undertook in the past the job of procuring rare chemicals for a few scientists, but the experience has shown the need for a central agency to help the research workers.

Students' Seminar at Florence

The World Federation of United Nations Association, Paris, is organising an International Seminar for students at Florence, Italy, form May 22 to June 6, 1950, on the occasion of the fifth general conference of Unesco. The Seminar will be preceded by an art tour in Italy, arranged by the Students' Committee of the Societa Italiana per la Organizzazione Internazionale. The Seminar is intended to give to students interested in international affairs an insight into the work of the UNESCO Conference and thus enable them to appraise the cultural problems claiming the attention of this world organisation. This will also give them an opportunity to observe the technique of a large international conference. Student organisations and other bodies in India who may like to participate in the proposed seminar may correspond direct with the Secretary-General of the Student Commission, World Federation of United Nations Associations, Education Commission, UNESCO House, 19-Avenue Kleber, Paris 16.

National Archives of India

The records of the Survey of India ranging from 1777 to 1898 formed one of the most important acquisitions of the National Archives of India during the year 1947, according to the *Annual Report of the National Archives* for that year, which has just been published.

Among the most important papers in this collection are: Paper on Astronomical Observations (1789-1828) Lambton and Everest Papers (1801-1825), Du Vernet Records on Himalayan Survey (1841-43, 1848-54) and Journals and Journeys in Tibet 1861. Most interesting from the Indian point of view are the papers relating to Indian Surveyors such as—Papers of Kushal Singh and Ghanashyam Das on Punjab and Kashmir Survey (1809), and particularly the collection of papers relating to Radhanath Sikdar (1849-57) one of the most brilliant Indians to have ever been associated with the urvey of India.

The Preservation Branch of the Department has succeeded in rehabilitating 1,56,000 sheets of documents and in treating about 9,400 bound volumes with leather preservative mixture in order to increase their durability and strength. About 4,000 volumes of records were fumigated with thymol spray and paradicholorobenzene as a protective measure against fungi and insects.

The Research Laboratory of the Department continued to carry on experiments with various types of insecticides like DDT and gammexane with a view to determining their suitability for Records Offices and Libraries. Among other investigations undertaken were those on the problem of preserving art paper under tropical conditions. A liberal grant from Government enabled the Department to place orders for several appliances needed by the Research Laboratory and the Preservation Branch including a pH meter for determining the acid contents of the documents sent for repair and a photo-micrographic camera for taking enlarged photos of fungi and insects which infest the records.

The Photographic Section of this Department was enriched by the addition of a microfilm positive printer and an order was placed for the purchase of two more cameras. The Department succeeded in getting microfilmed and enlarged several important manuscripts, among these were a few of Rabindranath Tagore in pencil and some of his earliest writings.

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